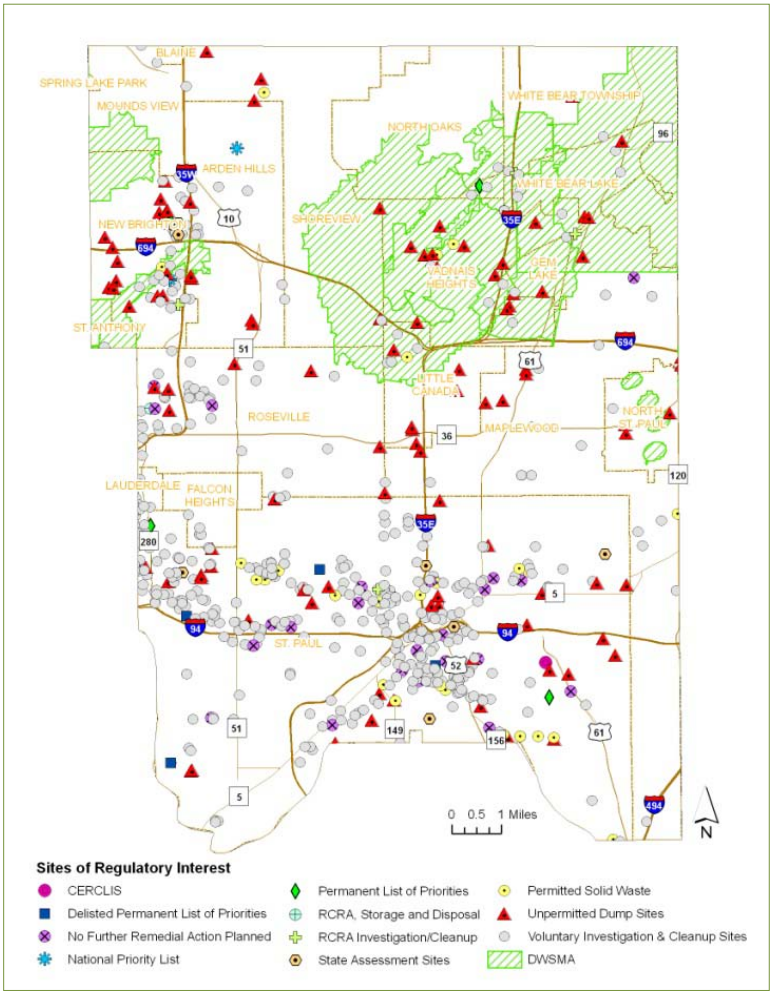
RAMSEY COUNTY GROUNDWATER PROTECTION PLAN

2010

For: Ramsey County Board of Commissioners
By: Ramsey Conservation District



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1.1 EXECUTIVE SUMMARY

On behalf of Ramsey County and the Ramsey County Board of Commissioners, the Ramsey Conservation District (RCD) has updated the *Ramsey County Groundwater Protection Plan* in an effort to protect the vital drinking water and groundwater resources of Ramsey County. The previous plan was published in 1996. Because groundwater is not limited by political boundaries, a County Groundwater Protection Plan is needed to coordinate groundwater protection policies and activities on a wider basis than the municipal or watershed level.

Section 1.0 discusses the purpose and goals of the Plan, as well as threats to groundwater and other broad concepts related to its' protection, such a funding and enforcement. Implementation of groundwater protection initiatives included in this Groundwater Protection Plan is subject to available funding by local units of government. Enforcement of Groundwater Protection Plan provisions results from the fact that watershed plans and municipal water management plans must conform to County Groundwater Plans. If watershed plans and municipal water management plans do not conform with the County Groundwater Protection Plan, the Board of Water and Soil Resources (BWSR) could decline to approve the respective plans.

Section 2.0 addresses the issue of why it is important to protect groundwater. Twenty percent of Ramsey County residents are completely dependent on groundwater for their drinking water supply. All County residents rely at least partially on groundwater for their water supply.

Section 3.0 reviews the groundwater protection planning process, as well as, plan structure and plan review. The process was collaborative and included representatives of watershed management organizations, cities, as well as, regional and state agencies.

Section 4.0 describes the geology and hydrogeology pertaining to protecting groundwater in the near-surface, unconfined aquifer as well as the deeper bedrock aquifers.

Section 5.0 provides details on the initiatives in the Plan that will protect groundwater in Ramsey County. Specific steps are set forth that will have a measurable effect on groundwater quality, sustainability, and the understanding of this critical resource.

The Plan was prepared by with extensive input from local, Ramsey County, regional, and state agencies. The completed Plan undergoes a public review process as outlined in Minnesota Statute §103B.255. After the review is complete the Plan goes before Ramsey County Board of Commissioners for plan adoption. After County adoption, the implementation of the Plan will be

the responsibility of the appointed County department or entity, such as the Ramsey Conservation District.

The Plan contains groundwater data and issues developed relevant to Ramsey County residents. It maps an implementation and update strategy to be followed in the years ahead.

1.2 INTRODUCTION

State and local agencies address many aspects of groundwater protection but an integrated, countywide focus on the water resource would provide many benefits. County government is best positioned to protect groundwater and has the greatest opportunity to achieve it through partnerships with cities, water supply authorities, water management organizations, the Metropolitan Council, and state agencies. At the Ramsey County Board of Commissioners' request, the RCD has dedicated part of the Agricultural Fee revenue to groundwater protection.

This Plan conveys the message of water supply aquifer vulnerability in the face of current and future land use, as well as the sense that more needs to be known about the quality and quantity of groundwater in Ramsey County. Management of this vital resource is not possible without public investment. This Plan sets out a path to move forward with countywide groundwater protection.

Without adequate funding for this Plan's implementation, our shared groundwater resources face increasing threats to quality and quantity. The status quo is not sustainable.

The Ramsey Conservation District, which lacks taxing authority, has limited funding for its' conservation programs but has placed groundwater protection as its' number one priority. Identification of other sources of funding is ongoing. Cost-sharing relationships between Ramsey County, water management organizations, cities, State agencies, and the 2008 Clean Water Land and Legacy Amendment sales tax funds are all possible sources of funding for the groundwater protection programs proposed in this Plan.

Ramsey Conservation District, as the author of this Plan, has the ability to lead its' implementation. Following Ramsey County plan adoption, the cooperative institutional structure for protecting Ramsey County's groundwater will be put in place.

Minnesota Water Law Statute §103B.255 provides the authority for metropolitan counties to prepare and adopt county groundwater plans, and implement their policies. Pursuant to this statute, the Ramsey County Board of Commissioners passed Resolution No. 90-294, which delegated preparation of a groundwater plan to the Ramsey Conservation District. Plans are to cover periods of at least five years but no more than ten years from the date the Board of Water and Soil Resources (BWSR) approves the plan. The State statute §103B.255, Subdivision 8, stipulates that "Any political subdivision or watershed management organization that expects that substantial amendment of its plans would be necessary in order to bring them into conformance with the county groundwater plan shall describe as specifically as possible, within its comments, the amendments that it expects would be necessary and the cost of amendment and

implementation. Differences among local governmental agencies regarding the plan must be mediated."

The original Ramsey County Groundwater Protection Plan was written in response to the Minnesota Groundwater Protection Act of 1989 that emphasized the importance of protecting groundwater resources, as well as to the concerns that local involvement was a necessary part of this protection. Like this revised Plan, that 1996 Plan was generated through an open process involving meetings with a diverse Technical Advisory Committee. The 1996 Plan defined the resource and recommended several policies and activities to protect groundwater. These policies were not required to be adopted by any level of local government. As a result, few of the ideas were implemented. The approach for this Plan differs from that of the former Plan, in that it advocates specific initiatives, policies, and programs.

Ramsey County is fortunate to currently have an adequate supply of groundwater which helps to sustain its potable, industrial, and commercial water use base as well as providing water to our lakes, streams, and wetlands. However, the Metropolitan Council's 2009 Metropolitan Area Master Water Supply Plan states that while groundwater supplies are adequate for the present, projected demand may result in localized aquifer drawdown around pumping centers and that this drawdown may, in turn, cause unwanted localized effects such as contaminant migration, well interference, and lowering of surface water levels in some lakes, streams, and wetlands within the county. Severe localized drawdown is expected to occur particularly near high growth centers, such as in neighboring Washington County and southeast Ramsey County.

According to the Metropolitan Council, municipalities and businesses in Ramsey County extract approximately 33 billion gallons of groundwater each year from several aquifers that lie beneath the County. The Environmental Quality Board also states that as of 2005, Ramsey County is the only Minnesota County for which the "net water use" is more than 100 percent of recharge within the County.

The Surface Water Management section of the *Ramsey County 2008 Comprehensive Plan* stated that "Baseline water quality monitoring and other data collection will continue to quantify problems and prioritize management strategies". The County has been conducting surface water monitoring since the early-1980s. This type of resource management should be extended to groundwater monitoring in order to define the long-term status of this vital, but vulnerable, asset.

Groundwater contamination and sustainable water volume usage are also issues facing Ramsey County. Groundwater plumes (contaminants carried downgradient with moving groundwater) from the Twin Cities Army Ammunition Plant and 3M have impacted our county's aquifers, as shown below in Figure 1-1. There have been two results: fewer options for future groundwater resource expansion at a time of projected increasing groundwater demand and also more expensive cleanup requirements.

State and local agencies address many aspects of groundwater protection but an integrated, countywide focus on the water resource would provide many benefits. County government is best positioned to protect groundwater and has the greatest opportunity to achieve it through

partnerships with cities, water supply authorities, St. Paul Regional Water Services, water management organizations, the Metropolitan Council, and state agencies.

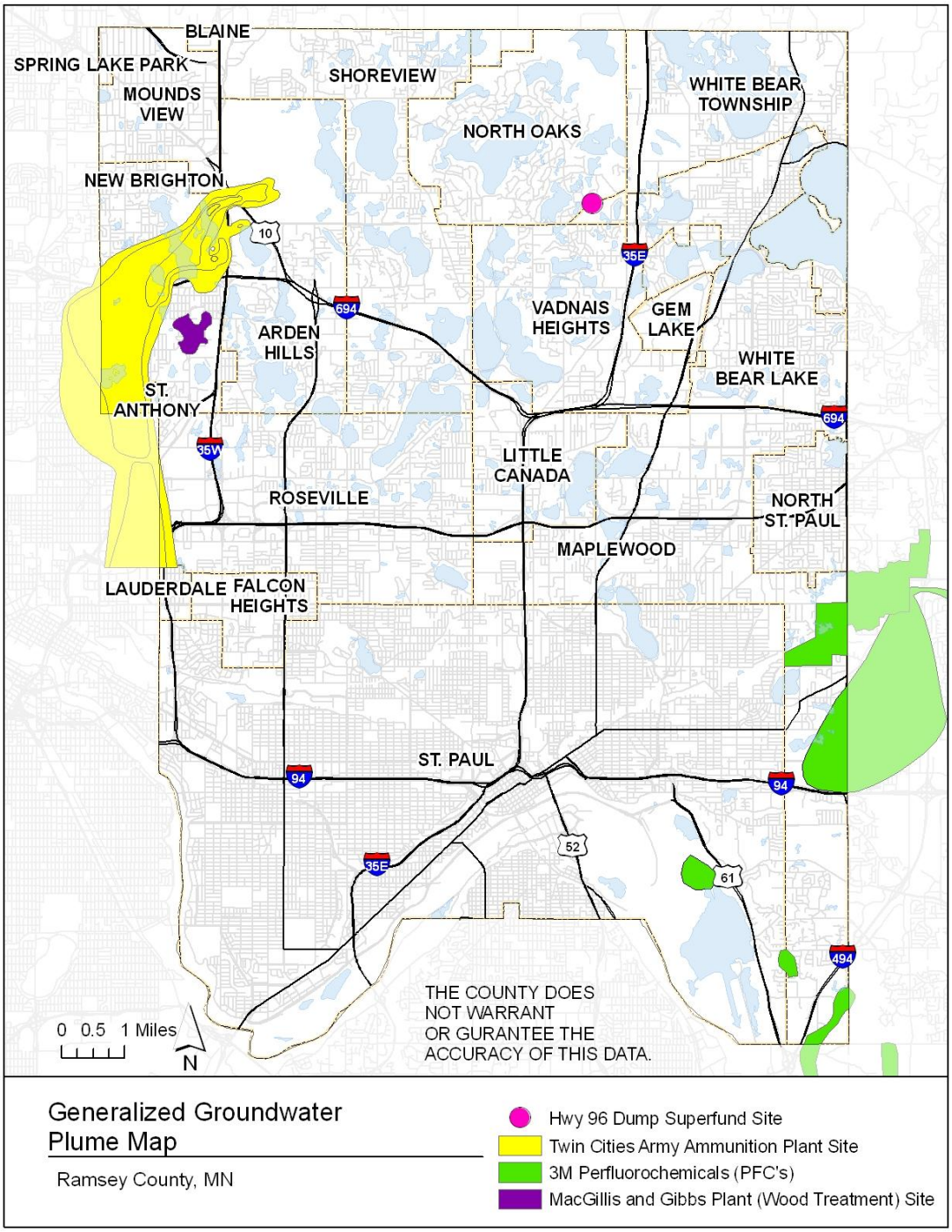


Figure 1-1 Groundwater Plume Map
(Used with permission of the Star Tribune, from the series "The Longest Cleanup," Sept. 16-18, 2007; reported by David Shaffer, graphics by Billy Steve Clayton, ©2007 Star Tribune.)

1.3 PURPOSE

The purpose of the Ramsey County Groundwater Protection Plan is to act as a centralized policy and strategy document to require the implementation of protection programs and activities that the County, cities, and other local units of government will utilize to protect groundwater.

1.4 GOAL

The primary goal of the Ramsey County Groundwater Protection Plan is to protect and maintain the quality and quantity of groundwater resources, now and in the future, by:

- monitoring the status of groundwater quality and quantity in Ramsey County,
- identification of existing contamination, and
- prevention of further releases of contaminants.

1.5 GUIDING PRINCIPLES

- Groundwater is an essential natural resource for the present and future needs of the residents and industries of Ramsey County, with domestic water supply being the highest water allocation priority, as per *Minnesota Statutes*, Section 103G.261.
- Groundwater contamination and quantity sustainability issues represent severe threats to public health, environmental quality, and economic development.
- Groundwater contamination is a foreseeable problem and preventing contamination is the surest and most cost effective method of protecting groundwater quality, public health, and economic viability.
- Periodic checks of groundwater baseline status are critical to managing this vital resource.
- Proposed initiatives should be tangible and verifiable.
- Ramsey Conservation District is the unit of local government with the capacity to take on these responsibilities.

1.6 FUNDING GROUNDWATER PROTECTION

When and where possible, water management jurisdictions (watershed districts and joint powers water management organizations) and public water providers are anticipated to be the primary financial resource for groundwater protection implementation in Ramsey County. Ramsey County, through its Conservation District, should coordinate protection initiatives and seek to secure State and Federal funding opportunities.

Ramsey County is required, by State and Federal regulations, to provide a wide variety of mandated programs: transportation, public safety, and health and human services to residents. With limited tax resource available for non-mandated services, Ramsey County relies on the public funding capabilities of "special purpose government agencies" such as water management jurisdictions to finance most surface water resource protection activities. The Metropolitan

Surface Water Management Act of 1982 requires that all water management jurisdictions address the protection of groundwater. In addition, public water providers are required by State law to develop and implement wellhead protection programs. Public water providers, through utility fees, have the ability to collect revenues for the protection of groundwater resources.

Unlike surface water resources which can be managed within well defined and limited physical boundaries, groundwater is a natural resource feature of large geographic areas. That is to say, groundwater resources encompass multiple surface watersheds. For this reason, groundwater within Ramsey County must be managed by a local government agency that will include and help coordinate the efforts of the water management jurisdictions and water providers within Ramsey County.

As stated in this Plan, groundwater protection is most effective if managed on as broad an area as possible to cover larger parts of the subsurface aquifers that store water for drinking water and groundwater dependent resources. While some provisions of this Plan can be implemented individually by local government units within their borders, others must be addressed either outside those borders or occur on too large a scale for effective separate management. With the cooperation and support of the water management jurisdictions and water providers, an organization with countywide focus can implement those provisions of the Ramsey County Groundwater Protection Plan that require authority outside of the local government units' jurisdictions.

The State statutes that pertain to groundwater management responsibility are included in Section 1.13 on page 15.

1.7 USES OF GROUNDWATER

Groundwater is used by approximately 15 to 20% of Ramsey County residents for their sole source of public or private drinking water. The following table shows water sources by city:

Water Supply Sources for Municipalities in Ramsey County	
Groundwater is the sole source of water for:	St. Paul Regional Water Service (mostly surface water) is the provider of water for:
Blaine Gem Lake Mounds View New Brighton North Oaks North St. Paul Saint Anthony Shoreview Spring Lake Park Vadnais Heights White Bear Lake White Bear Township	Arden Hills Falcon Heights Lauderdale Little Canada Maplewood Roseville St. Paul

The St. Paul Regional Water Service derives most of its' drinking water supply from surface water from the Mississippi River, but approximately 7% of all the water they provide is groundwater. Also, thousands of residential homeowners, industrial users, and several mobile home communities located throughout the County, rely upon their own private wells for water supply.

Most of the listed cities have adopted or drafted Water Supply Plans related to their water use.

1.8 THREATS TO GROUNDWATER

In Ramsey County, numerous current and past land-use activities threaten the quality of our groundwater resources, the public's health, and the economic stability of businesses, communities and cities. A preliminary search identified more than 10,000 existing and potential sources of contamination documented by the MPCA, within our county borders. These included known releases as well as underground storage tanks, hazardous waste generators, illegal dumping, spills, leaking pipelines, failing septic systems, etc.

Specific threats come from the following:

- Stormwater infiltration and chlorinated hazardous waste (industries, dry cleaners, gas stations, above ground storage tanks, and road salt.
- Known groundwater plumes that spread downgradient.

- Unused, unsealed residential and commercial/industrial water wells that can be a "path of least resistance" for spreading contaminant plumes by virtue of damage to boreholes.
- Undetected contaminant releases that may have impacted groundwater.

What is the greatest threat to groundwater in Ramsey County?

Because we currently lack suffient groundwater resource monitoring, not enough is known about the ongoing status of our groundwater. The greatest risk to Ramsey County's groundwater is from all that we do not know about this vulnerable asset.

Aquifers cannot protect themselves from becoming contaminated and the cleanup of polluted groundwater is technically challenging and expensive. Only well-conceived and coordinated land-management efforts and monitoring can ensure the protection of our important groundwater resource. The Technical Advisory Committee emphasized that while surface water is monitored, ambient groundwater water quality and water table elevation data collection and assessment is not currently performed.

1.9 GROUNDWATER CONSERVATION

Conserving groundwater is a significant issue for a densely populated county like ours. Ramsey County is the only county in Minnesota that uses more groundwater than infiltrates back to the groundwater within the boundaries of the county (Figure 1-2). This is due to Ramsey County's small area combined with its large population. In effect, much of the groundwater Ramsey County uses was infiltrated elsewhere.

The Metropolitan Council's 2009 Metropolitan Area Master Water Supply Plan states that while groundwater supplies are adequate for the present, projected demand may result in localized aquifer drawdown around pumping centers and that this drawdown may, in turn, cause unwanted localized effects such as contaminant migration, well interference, and lowering of surface water levels in some areas within the county. Localized drawdown is expected to occur particularly near high growth centers, such as in neighboring Washington County.

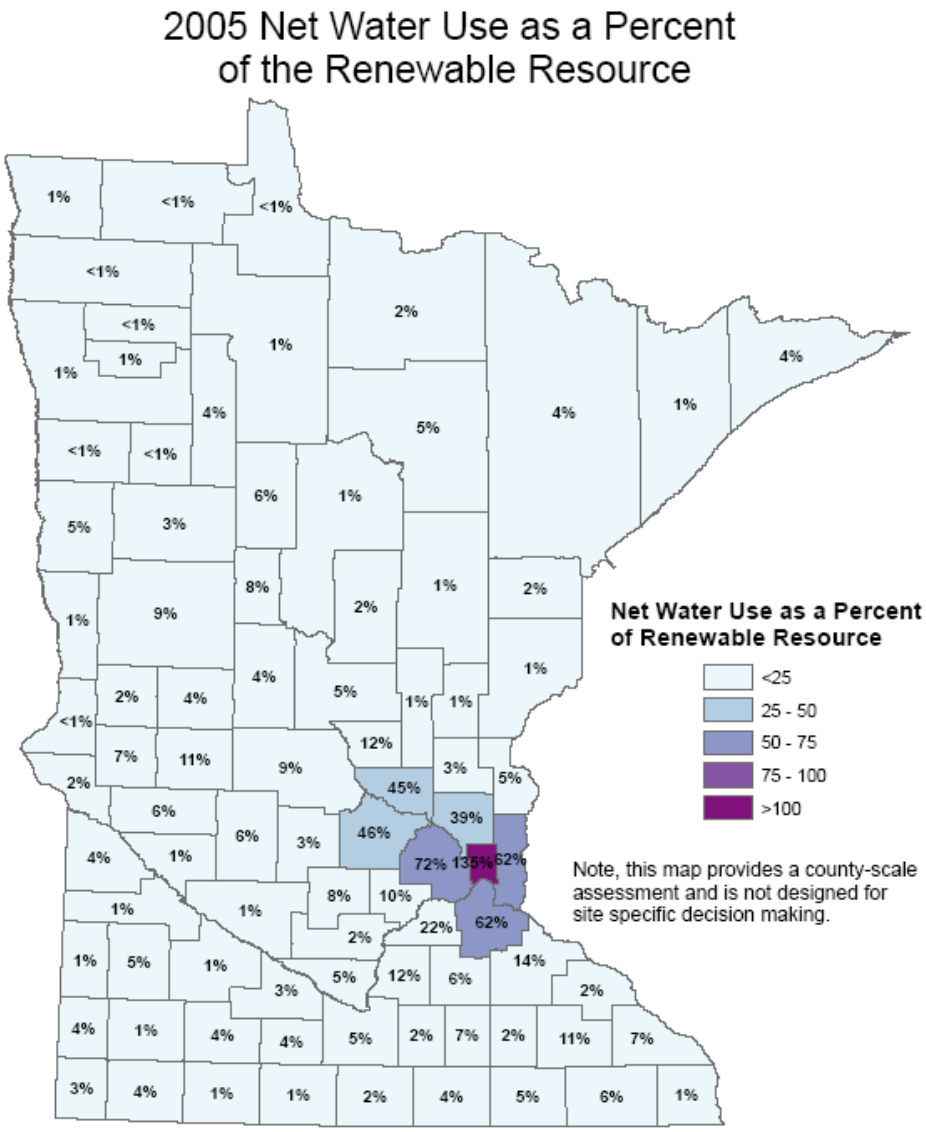


Figure 1-2 Net water use
(Source: Environmental Quality Board)

1.10 LOCAL RESPONSIBILITY FOR PROTECTING GROUNDWATER

In 2008, the Minnesota State Legislature passed Minnesota Statutes, Section 103G.291, subd. 4. This requires that by January 1, 2010, metropolitan public water suppliers serving more than 1,000 people must employ water use demand reduction measures, including a "conservation rate structure", before requesting approval from the commissioner of health to construct a public water supply well or requesting an increase in the authorized volume of appropriation.

Conservation rates are water prices that increase with increased consumption volume. More information on water conservation rates can be found at the DNR's site (http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/conservation.html).

Groundwater contamination is a local problem. Water supplies are provided locally either by a homeowner, community, business or a local unit of government. Contamination sources in Ramsey County are within a short vertical distance of the aquifers which they can potentially impact. A program for coordination of groundwater protection is necessary for Ramsey County. The roles of various environmental agencies are fully defined in a document called "*Water Resources Management in Minnesota*" and included in Appendix A.

Who Protects Groundwater?

- Environmental Protection Agency – sets standards/reporting requirements
- Department of Natural Resources – water appropriation permits/observation wells/review & approval of Water Supply Plans
- Minnesota Department of Health – well construction/sealing/supply well monitoring/wellhead protection/development of groundwater Health Risk Limits
- Minnesota Pollution Control Agency – contamination cleanup/USTs/hazardous waste permitting
- Board of Water and Soil Resources – set planning requirements
- Metropolitan Council – regional water supply policy/review & approval of Water Supply Plans
- Watersheds/Water Management Organizations – historically: surface water focus
- St. Paul-Ramsey County, Public Health – Permit/inspect hazardous waste facilities
- Ramsey Conservation District – countywide groundwater planning
- Cities/water providers – supply water/wellhead protection plans

Groundwater is monitored in association with known contamination problems and limited ambient groundwater monitoring is done by the MPCA. There is no regulatory agency which fully coordinates state, federal and local policies relating to groundwater protection. A void exists that calls for additional local groundwater protection.

1.11 PROTECTIVE MEASURES

Ramsey County and its' partner organizations can implement the initiatives included in this Groundwater Protection Plan and greatly reduce the threat to the quality and quantity of groundwater used by municipal and private well owners. Several regulatory agencies have groundwater protection as part of their mandate, but there is currently no state or local agency that has local groundwater protection as its mission. The initiatives proposed in this Plan can close those gaps.

Cities that provide water to their residents are required to generate Wellhead Protection Plans (WHP plans) and submit them to the Minnesota Department of Health (MDH). These WHP plans fill a different role than this Groundwater Protection Plan. They require cities to delineate a wellhead protection area around their wells and locate potential sources of contamination. However, little in the way of active groundwater protection activities is required. This is left up to the water provider.

Some cities in Ramsey County have completed Wellhead Protection Plans and the others must wait to begin the process until the MDH has the necessary staff time. Cities have indicated that any assistance RCD could render, with regard to their Wellhead Protection Plans, would be of great help. Taking a countywide approach would also be more effective because aquifers transcend local boundaries.

The Minnesota Groundwater Protection Act of 1989 emphasizes the importance of protecting all the groundwater resources of Minnesota. Metropolitan county groundwater planning was initiated in response to concerns that more local involvement was needed to adequately protect groundwater resources from contamination. **Prevention and early detection of contamination are the safest and most cost-effective methods of protecting groundwater.**

Local governments possess several regulatory controls such as planning and zoning, licensing, inspection, permitting, and inspection. In the publics' best interest, cities, watershed management organizations, the Ramsey Conservation District, and Ramsey County departments and agencies should use these tools and other measures to help protect the public, their groundwater resources, and their economic viability.

The Groundwater Protection Plan has specified a variety of programs and activities that protect groundwater in Ramsey County. A proactive and cooperative approach between cities, county services, watershed management organizations, as well as regional and state agencies is emphasized in this Plan. Roles and responsibilities are recommended in Section 1.13 (below) and Chapter 5 of the Plan for the implementation of the groundwater protection programs and activities.

1.12 JUSTIFICATION FOR PROTECTION OF GROUNDWATER

Compared to the complexity and cost of groundwater contamination incidents, groundwater protection is a fairly straightforward and economical effort. Local groundwater protection is a multi-pronged process and several groundwater resource protection initiatives are outlined in the Plan.

1.13 INITIATIVES TO PROTECT GROUNDWATER

Groundwater protection is a shared responsibility. Roles differ between the various parties in Ramsey County. The following table shows brief descriptions of the initiatives proposed by the Technical Advisory Committee. Additional details are shown in Section 5.1.

INITIATIVE	LEADER	PARTNERS
1. RCD and the proposed Ramsey Co. Groundwater Partnership to assume leadership role in countywide groundwater protection and RCD to manage groundwater database.	Ramsey Conservation District	Watershed districts/WMOs/water providers/ Ramsey County Groundwater Partnership
2. Annual ambient groundwater quality data acquisition program - city wells and selected observation wells.	Ramsey Conservation District	Watershed districts/WMOs/Ramsey County Groundwater Partnership
3. Continuous automated groundwater elevation data collection program.	Ramsey Conservation District	Watershed districts/WMOs/Ramsey County Groundwater Partnership
4. Fund sealing of unused residential wells cost-share program. Participation and qualification details are left to the discretion of the funding partners.	Ramsey Conservation District	Watershed districts/WMOs/water providers
5. Education and outreach to LGUs and public on topics related to Ramsey County groundwater (i.e., consumption, lawn watering).	Ramsey Conservation District	Watershed districts/WMOs/water providers
6. RCD and the Ramsey County Groundwater Partnership will assist water providers with land use management issues and developing land use rules in DWSMAs as well as assisting non-municipal community water suppliers with their Wellhead Protection Plans.	Ramsey Conservation District	Cities/water providers/ Ramsey County GIS User Group

INITIATIVE	LEADER	PARTNERS
7. Provide expertise on surface water – groundwater interaction to water jurisdictions and LGUs in order to protect groundwater. Engage in long-term monitoring.	Ramsey Conservation District	Watershed districts/WMOs/cities
8. SPECIAL PROJECT: RCD will coordinate an evaluation of two possible sources of groundwater contamination: hazardous waste generators and County unpermitted dump sites. Solutions will take a risk-based approach.	Ramsey Conservation District	St. Paul-Ramsey County-Public Health/MPCA/ Minnesota Dept. of Health/cities
9. SPECIAL PROJECT: RCD will undertake a review of MPCA files related to approximately 80 unpermitted dumps to look for indications of groundwater impacts.	Ramsey Conservation District	St. Paul-Ramsey County-Public Health /MPCA/ Minnesota Dept. of Health/cities
10. SPECIAL PROJECT: Assemble GIS database of stormwater infiltration structures that could pose threats to groundwater in emergency response spill situations and infiltration from non-point sources.	Ramsey Conservation District	Watershed districts/WMOs/ cities/ Ramsey County-Emergency Management & Homeland Security
11. Encourage Met Council and MPCA to proceed with contaminated soil and groundwater plume mapping project for the for the 11-county Metro area. Partners will provide relevant groundwater information. RCD will provide information from file review of MPCAs Unpermitted Dumps and County dump site list.	Metropolitan Council/Ramsey County Groundwater Partnership	Not applicable
12. Emphasize stormwater reuse where possible by water organizations to help cities meet non-degradation standards.	Watershed districts/WMOs/ cities' permitting agencies	Ramsey Conservation District

INITIATIVE	LEADER	PARTNERS
13. Permitting process should be used to direct stormwater infiltration away from contaminated soils or known areas of groundwater contamination.	Watershed districts/WMOs and cities' permitting agencies.	Ramsey Conservation District
14. Water management organizations should identify and map groundwater dependent natural resources in order to protect them from degradation.	Watershed districts/WMOs	Ramsey County Groundwater Partnership
15. Support open space and land use easements in hydrologically sensitive areas as passive mechanisms that protect groundwater.	Cities' planning departments and water providers	Ramsey Conservation District/Ramsey County Groundwater Partnership/Ramsey County
16. County adoption of State of Minnesota code for Individual Sewage Treatment Systems in order to assure adequate dispersal and treatment of domestic sewage before it infiltrates to groundwater.	St. Paul-Ramsey County-Public Health	Ramsey Conservation District and municipalities

1.14 AUTHORITY AND ENFORCEMENT PROVISIONS

Various groundwater-related statutes are listed below to document responsibilities that result from State and County legislation.

The original Ramsey County Resolution 90-294 by the Ramsey County Board of Commissioners dated May 15, 1990, delegating the responsibility to write a Ramsey County Groundwater Protection Plan to the Ramsey Conservation District, dated May 15, 1990 states:
"WHEREAS, An adequate supply of good quality groundwater is essential to the well-being of the citizens of Ramsey County; and
WHEREAS, The aforementioned groundwater resources contribute to the favorable quality of life in Ramsey County, and should be protected for the future; Now, Therefore Be It
RESOLVED, That Ramsey County prepare and adopt a groundwater plan according to Minnesota Statutes, Section 473.8785; and Be It Further
RESOLVED, That preparation of the plan for adoption by Ramsey County as provided by MS 473.8785, Subdivision 2, is hereby delegated to the Ramsey Soil and Water Conservation District."

Enforcement of Groundwater Protection Plan provisions results from the fact that watershed plans and municipal water management plans must conform to County Groundwater Plans. Thus, when a County Groundwater Protection Plan is approved, it affects both Watershed Plans and municipal Water Management Plans. Enforcement follows from those respective plans. If watershed plans and municipal water management plans do not conform with the County Groundwater Protection Plan, the Board of Water and Soil Resources (BWSR) could decline to approve the respective plans. The relevant statutes are as follows:

Minnesota Water Law Statute §103B.255 (Groundwater Plans) enables metropolitan counties to prepare, adopt, and implement county groundwater plans. Specifically, Subdivision 7 stipulates a Plan must *"set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government"*. Also, Subdivision 8, stipulates that *"Any political subdivision or watershed management organization that expects that substantial amendment of its plans would be necessary in order to bring them into conformance with the county groundwater plan shall describe as specifically as possible, within its comments, the amendments that it expects would be necessary and the cost of amendment and implementation. Differences among local governmental agencies regarding the plan must be mediated."*

Minnesota Water Law Statute §103B.231 (Watershed Plans) states that watershed management plans must be prepared and implemented in conformance with groundwater plans. Subdivision 1. Requirement (a) *"A watershed management plan is required for watersheds comprising all minor watershed units wholly or partly within the metropolitan area. For minor watershed units having more than 90 percent of their area within the metropolitan area, the watershed management plan must be prepared, adopted, and implemented in accordance with the requirements of sections 103B.205 to 103B.255."*

Minnesota Water Law Statute §103B.235 (Local Water Management Plans) states that local Water Management Plans must conform to watershed plans. Subdivision 1.Requirement (a) states that *"After the watershed plan is approved and adopted, or amended, pursuant to section 103B.231, the local government units having land use planning and regulatory responsibility for territory within the watershed shall prepare or cause to be prepared a local water management plan, capital improvement program, and official controls as necessary to bring local water management into conformance with the watershed plan within the time period prescribed in the implementation program of the watershed plan and, as necessary, shall prepare or cause to be prepared amendments to the local comprehensive plan."*

Excerpts from the Ramsey County Administrative Code *Section 4.60.00 Public Health* list various responsibilities that can relate to groundwater protection. Items excerpted from *4.60.30 Duties and Responsibilities:*

> *d. Develop and revise ordinances necessary to protect the public health and environment;*
> *e. Protect the environment through the implementation of plans, through education and consultation, and through compliance monitoring and enforcement of ordinances;*
> *i. Recommend the development of comprehensive public health policies and to advocate for the application of public health principles in County policies;*
> *l. Take a leadership role in setting standards for the provision of public health services in the community.*

Ramsey County's taxing authority for groundwater planning is allowed under Minnesota Water Law *Statute §103B.255 Subd. 13. Property tax levies*:

> *"A metropolitan county may levy amounts necessary to administer and implement an approved and adopted groundwater plan. A county may levy amounts necessary to pay the reasonable increased costs to soil and water conservation districts and watershed management organizations of administering and implementing priority programs identified in the county's groundwater plan."*

The DNR may consider the Ramsey County Groundwater Protection Plan in water appropriation decisions, according to the Minnesota Water Law *Statute §103G.271 Subd. 2. Appropriation and Use of Water.*

> *"Permits must be consistent with state and local plans. A water use permit may not be issued under this section unless it is consistent with state, regional, and local water and related land resources management plans if the regional and local plans are consistent with statewide plans." Thus, the DNR may use the Ramsey County Groundwater Protection Plan as a basis for water appropriation decisions."*

1.15 LOCAL IMPACTS

Local impacts due to provisions in this Plan are limited. RCD has dedicated a part of its Agricultural Fees toward groundwater protection. Remaining expenses are anticipated to be mostly borne by water management jurisdictions, on the basis of their willingness and ability to participate. The following entries represent the expected local impacts of those initiatives (Section 1.13) which may generate costs and/or administrative consequences for local units of government:

1. RCD and the proposed Ramsey County Groundwater Partnership to assume leadership role in countywide groundwater protection. RCD administration and project management will formalize leadership in implementing County Groundwater Protection Plan.

   Anticipated costs: RCD responsibility as part of staff resource time.

2. Countywide monitoring of groundwater for annual groundwater quality costs would be borne by water management jurisdiction partners on the basis of their willingness and ability to participate. This program is an ongoing budget item with broad support from the potential funding partners.

   Anticipated costs: Water quality monitoring is anticipated to cost $25,750 in the first year of implementation.

3. Countywide monitoring of water table elevation costs would be borne by water management jurisdiction partners on the basis of their willingness and ability to participate. This program is an ongoing budget item with broad support from the potential funding partners.

   Anticipated costs: Water level monitoring is expected to be $22,250 in the first year of implementation.

4. Cost-sharing of residential well sealing costs would benefit homeowners wanting or needing to seal unused drinking water wells and would provide a tangible benefit toward groundwater protection. Some watershed organizations have expressed interest in financially supporting this effort on the basis of their willingness and ability to participate. Community Development Block Grant funding supported a small $10,000 well sealing 50% cost-share program in 2009, administered by RCD.

   Qualifying residents would be eligible for 50% cost-share funding to seal their wells. RCD's experience indicates that elderly residents are the main recipients of this funding.

   Anticipated costs: Average total cost to seal a well = $1,020. Match = 50%.

5. Education and outreach is expected to provide water resource decision-makers with a framework for their determinations that could affect groundwater. No specific programs have yet been designed or proposed.

   Anticipated costs: No costs are known at this point.

6. This Plan encourages the development of land use regulations but has no requirements for water providers to develop such regulations in areas near municipal drinking water wells. However, RCD will be available to advise and consult with water providers on land use issues if requested.

   Anticipated costs: Land use regulations could involve unknown real and opportunity costs for land owners.

7. RCD can assist water management organizations and cities on issues related to surface water-groundwater interaction. Stormwater infiltration close to municipal drinking water wells is likely to be an issue.

   Anticipated costs: Mitigation practices, best management practices, and monitoring costs are highly variable and unpredictable.

8. Evaluation of hazardous waste generators and a County list of 264 unpermitted dumps. Costs would be borne by water management jurisdiction partners on the basis of their willingness and ability to participate.

   Anticipated costs: This is a one-year RCD budget item totaling $25,800. The time commitment and costs that the St. Paul-Ramsey County Department of Public Health could incur for meetings and file reviews are expected to be minor.

9. Review of 80 unpermitted dumps documented by the MPCA in Ramsey County. Some watershed organizations have expressed interest in financially supporting this effort on the basis of their willingness and ability to participate.

   Anticipated costs: This is a one-year RCD budget item totaling $31,650. Partner funding has been secured.

10. Assemble a GIS database and map of stormwater infiltration structures that could pose threats to groundwater in emergency response situations and from infiltration from non-point sources of stormwater. Some watershed organizations have expressed interest in financially supporting this effort on the basis of their willingness and ability to participate.

    Anticipated costs: This is a one-year RCD budget item totaling $20,600. Partner funding has been secured.

11. Encourage Met Council and MPCA to proceed with contaminated soil and groundwater plume mapping project for the for the 11-county Metro area. Cities, watershed organizations, State agencies, and private developers would benefit from awareness of local groundwater contamination locations. Groundwater planning and redevelopment of "brownfield" areas would benefit directly.

    Anticipated costs: No apparent local cost.

12. Emphasize, where possible, stormwater reuse in stormwater permitting process by water management organizations to help cities meet anticipated non-degradation standards. Stormwater would be reused on site. Typically for irrigation of planting areas. Long-term savings result from reduced municipal water costs. Property owner permitees would bear the costs. The number of these projects is expected to be limited and it is anticipated that they will be only considered by permitees where and when they make sense financially.

    Anticipated costs: Capital costs vary based on project size. Example costs:
    a. 65,000-gallon cistern for office tower = approx. $175,000.
    b. City of St. Anthony's 500,000-gallon subsurface cistern = approximately $1,000,000.

13. Water management organization permitting process should direct stormwater infiltration away from contaminated soils or known areas of groundwater contamination. In recent years, water management organizations have required permitees to infiltrate larger volumes of stormwater rather than direct it to municipal stormwater systems. This reduces the load of sediment and contaminants to surface water bodies like lakes and streams, as well as reducing the peak flows in streams that contributes to stream bank erosion.

    Infiltrated stormwater to contaminated areas may mobilize soil contaminants. The subsequent contamination may cause off-site groundwater and soil vapor impacts to other businesses and neighbors.

    Stormwater infiltration is should be directed away from contaminated soils. Water organizations or cities will direct developers to prove soil is clean by requiring the submittal of a Phase I Environmental Site Assessment (ESA) and/or documenting of soil conditions with a soil sample. This level of screening is unnecessary within public rights of way unless previous polluting land use activities are suspected.

    Property owners are already assuming most of these costs. Watershed districts in Ramsey County are already including this in their permit requirements. In areas regulated by WMOs, city permitting departments will have to establish this requirement.

    Anticipated costs:
    a. Laboratory analysis (soil): approximately $100-200/sample

b. Existing Phase I ESA: typically already completed for lending institutions by property owner on all property transactions and real estate loans.

14. Water management organizations should identify and map groundwater dependent natural resources in order to protect them from degradation. Surface water resources such as some lakes, streams, springs, and wetlands are dependent on groundwater flow for their existence. This means that flows and water elevations of these resources could be reduced, leading to the alteration of these ecosystems. Surface water levels could be threatened by long-term declines in groundwater elevations.

    For those water management jurisdictions that have not completed them, groundwater dependent natural resource evaluations should be conducted to determine the relationship between surface water features and groundwater. This could take the form of a comparison between the regional water table elevation and the elevations of surface water features.

    Watershed districts and WMOs would have this responsibility. Several watershed districts are currently undertaking this type of study.

    Anticipated costs:
    a. Water management organizations should expect a general cost of $500 per square mile for conducting the assessments.
    b. Clean Water Partnership, dedicated sales tax grants are a potential source of funding.

15. County and municipal support for open space and land use easements in hydrologically sensitive areas as passive mechanisms that protect groundwater. Open space has aesthetic aspects but in addition is a valuable factor in groundwater protection. Open space a valuable offset to other, more intensive land uses (i.e., commercial or industrial development) that carry with them risks of both point and non-point source pollution.

    Anticipated costs:
    Costs associated with creating open space involve unknown real costs and opportunity costs. Tangible costs could include land purchase and upkeep. Opportunity costs would be compared to the economic benefit of developing a property. Potential sources of funding for open space could be Lessard-Sams Outdoor Heritage grants from dedicated sales tax funds.

16. County adoption of State of Minnesota code for Individual Sewage Treatment Systems in order to assure adequate dispersal and treatment of domestic sewage before it infiltrates to groundwater. There are about 1,800 septic systems in 13 of the 17 municipalities in Ramsey County. The number ranges from 1,240 in North Oaks, to 1 in Mounds View. Most residents in North Oaks also have private drinking water wells.

County adoption of State of Minnesota code for Individual Sewage Treatment Systems would assure that failing treatment systems would be replaced and this would help protect residents' drinking water supplies.

Estimated costs to homeowners:
The original design and installation cost of an individual on-site septic system typically ranges from $3,000 to greater than $10,000, depending on the size of home, the site conditions, and local ordinance requirements. In unusual circumstances, some can cost even more.

One possible source of low interest funding for residents is the Minnesota Department of Agriculture, Agriculture Best Management Program: 3% APR Loan Program.

1.16 ACKNOWLEDGEMENTS

This plan would not have been possible without the contribution of the planning committees. The Ramsey Conservation District thanks all of them for their advice and recommendations. The planning committees met three times between September and November of 2008. **Financial support was provided by the organizations (bold) listed below.**

District Administrator: Tom Petersen, Ramsey Conservation District
Groundwater Plan Coordinator: Geoff Nash, Ramsey Conservation District

Technical Advisory Committee		
1.	Mark Doneux & Bob Fossum	**Capitol Region Watershed District**
2.	David Kotilinek	City of North St. Paul
3.	Mark Maloney	City of Shoreview
4.	Michael MacDonald	Department of Natural Resources
5.	William O. Gangl	Gangl Well Drilling, Inc.
6.	Karen Eckman	**Grass Lake WMO**
7.	Chris Elvrum & Lanya Ross	Metropolitan Council
8.	Melissa Lewis & Eric Mohring	**Minnesota Board of Water and Soil Resources (Natural Resource Block Grant)**
9.	Bruce Olsen	Minnesota Department of Health
10.	Steve Thompson/Sharon Kroening	Minnesota Pollution Control Agency
11.	Janice Rettman	Ramsey County Board of Commissioners
12.	Terry Noonan	**Ramsey County-Public Works-Environment Department**
13.	Cliff Aichinger & Tina Carstens	**Ramsey-Washington Metro Watershed District**
14.	Doug Thomas	**Rice Creek Watershed District**
15.	John F. Blackstone, P. E.	**Saint Paul Regional Water Services**
16.	Norm Schiferl/Larry Carlson	**Saint Paul - Ramsey County Department of Public Health**
17.	Stephanie McNamara	**Vadnais Lake Area Water Management Organization**

18.	Lincoln Fetcher	**Valley Branch Watershed District**

Local Advisory committee:		
1.	Greg Hoag, Dir. of Public Works	City of Arden Hills
2.	John Lind, Util. Dept. Superintendent	City of Blaine
3.	Paul Emeott, Mayor	City of Gem Lake
4.	Heather Butkowski, City Administrator	City of Lauerdale
5.	Bill Blesener, Mayor	City of Little Canada
6.	Michael Thompson, Asst. City Engr.	City of Maplewood
7.	Nick Fleischhacker, Surface Water Specialist	City of Mounds View
8.	Kerry Thorne, Engineer	City of New Brighton
9.	Melinda Coleman, City Administrator	City of North Oaks
10.	Deb Bloom/Kristine Giga	City of Roseville/Arden Hills/Falcon Heights
13.	Terry Randall, Director of Public Works	City of Spring Lake Park
12.	Jay Hartman, Director of Public Works	City of St. Anthony
11.	Phil Belfiori, Water Resources Specialist	City of St. Paul
14.	Mark Graham, City Engineer	City of Vadnais Heights
15.	Mark Burch, City Engineer	City of White Bear Lake
16.	Joe Fox, Supervisor	Ramsey Conservation District
17.	John Freitag, Sr. Environmental Specialist	Washington County Public Health & Environment
18.	Bill Short, Clerk Treasurer	White Bear Township

2.0 Reasons to Protect Groundwater

2.1 IMPORTANCE OF GROUNDWATER

Groundwater is water that is located beneath the earth's surface in soil and geologic materials. Groundwater is stored in and flows through an intricate network of small pores, joints, fractures and solution cavities present in underground geologic sediment and rock formations.

Beneath Ramsey County lies a portion of a large groundwater geologic basin composed of several aquifer units which provide much of the water we use every day. Water wells are used to extract groundwater from aquifers. This groundwater is used for drinking, heating and cooling, irrigation, manufacturing processes, and a host of other needs. The quality of groundwater is dependent on its natural characteristics and whether any human introduced contaminants have entered the aquifers in which groundwater resides.

These aquifers are constantly undergoing recharge by the slow infiltration of rainfall at the surface. Soluble manmade materials are also carried with the rainwater. A cross section of metro-area geology is shown in Figure 2-1.

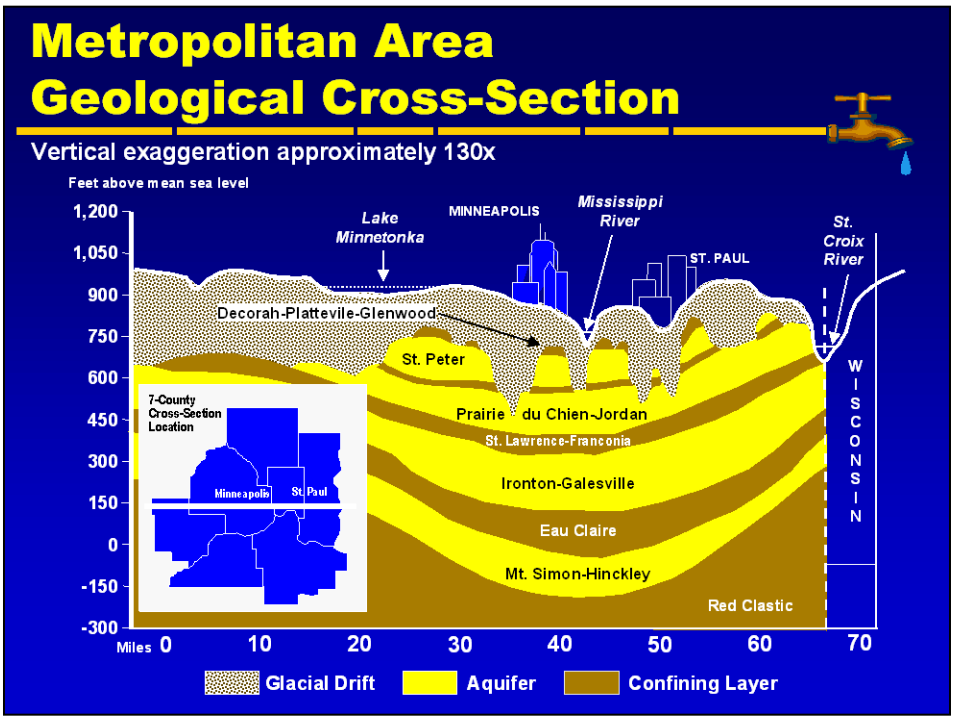


Figure 2-1 Metropolitan area cross section
(Source: DNR)

Groundwater is a vital natural resource to the residents, cities, and industries of Ramsey County. Approximately 26 billion gallons of groundwater are extracted each year in Ramsey County. The health and viability of the county's public, economy, and environment depend, in part, upon the wise use and management of our groundwater. Fortunately, Ramsey County has an abundant supply of groundwater but it faces growing threats to its sustainability.

Every citizen of Ramsey County is dependent upon groundwater resources to a certain degree. Groundwater serves as the sole water supply for 12 cities and approximately 20% of the county's residents (Table 1). Surface water provides St. Paul Water Services and their customers with about 93 % of the water they use. Groundwater contributes about 7 % of the total water distributed by St. Paul Water Services each year. The following table shows water sources by municipality:

Table 1 - Municipal Water Sources

Water Supply Sources for Municipalities in Ramsey County	
Groundwater is the sole source of water for:	St. Paul Regional Water Service (mostly surface water) is the provider of water for:
Blaine Gem Lake Mounds View New Brighton North Oaks North St. Paul Saint Anthony Shoreview Spring Lake Park Vadnais Heights White Bear Lake White Bear Township	Arden Hills Falcon Heights Lauderdale Little Canada Maplewood Roseville St. Paul

Over 4,000 documented active water wells exist in the county. Over 50 of these are used solely for municipal and non-municipal community public water supply, roughly 2,400 are privately owned and utilized for domestic purposes, and nearly 300 are operated for commercial and industrial uses. In addition, the many lakes, streams, and wetlands throughout the county are also interconnected with and depend upon groundwater for recharge. Table 2 shows the extent of groundwater dependence by city.

Table 2 - Municipal Water Supply Information- Ramsey County

Municipal Water Supply: Ramsey County					
City/Township	2000 population	Estimated % of population served by city water	Estimated % of city water supply from groundwater	Estimated % of population served by non-municipal community and private wells	Estimated % of population relying solely on groundwater for water supply
Arden Hills	9,652	97.7	*	2.3	2.3
Blaine[1]	--	--	--	--	--
Falcon Heights	5,572	100	*	0	0
Gem Lake	419	0	0	100	100
Lauderdale	2,364	99+	*	<1	<1
Little Canada	9,771	96.4	*	3.6	3.6
Maplewood	36,397	99+	*	<1	0
Mounds View	12,738	99+	100	<1	100
New Brighton	22,206	99+	100	<1	100
North Oaks	3,883	1	100	99	100
North St. Paul	11,929	99+	100	<1	100
Roseville	33,690	99+	*	<1	<1
St. Anthony[1]	2,449	100	100	0	100
St. Paul	287,151	97	7	3	3
Shoreview	25,924	99+	100	<1	100
Spring Lake Park[1]	45[2]	100	100	0	100
Vadnais Heights	13,069	99+	100	38.5	100
White Bear Lake	24,325	97.4	100	2.6	100
White Bear	11,293	85	100	15	100
All of Ramsey	511,427	92		8	26

[1]The city is not entirely within Ramsey County. [2]Number of households. *The Saint Paul Water Utility supplies these cities with their water supply. The Utility extracts most of its water from the Mississippi River via Vadnais Lake and augments this surface water with between 10-20% of groundwater from the Prairie du Chien-Jordan aquifer. Source: Cities, SPRWS, and Ramsey Conservation District.

2.2 WHY GROUNDWATER PROTECTION IS NECESSARY

In Ramsey County, the presence of high quality groundwater and the large quantities of groundwater consumed each year indicate the need to ensure adequate and safe supplies of water the future in order to sustain economic development in Ramsey County. Unfortunately, concerns regarding groundwater quality and quantity usually arise only after an unfortunate incident has occurred, such as drought or contamination of a well. Groundwater may be an unseen resource but as it migrates, it has a future use as surface water recharge.

Protecting groundwater can only be accomplished through well-conceived and coordinated regulatory efforts. Preventing contamination is the focus of this plan. The chart below (Figure 2-2) shows that the major use of groundwater in Ramsey County is for drinking water supply.

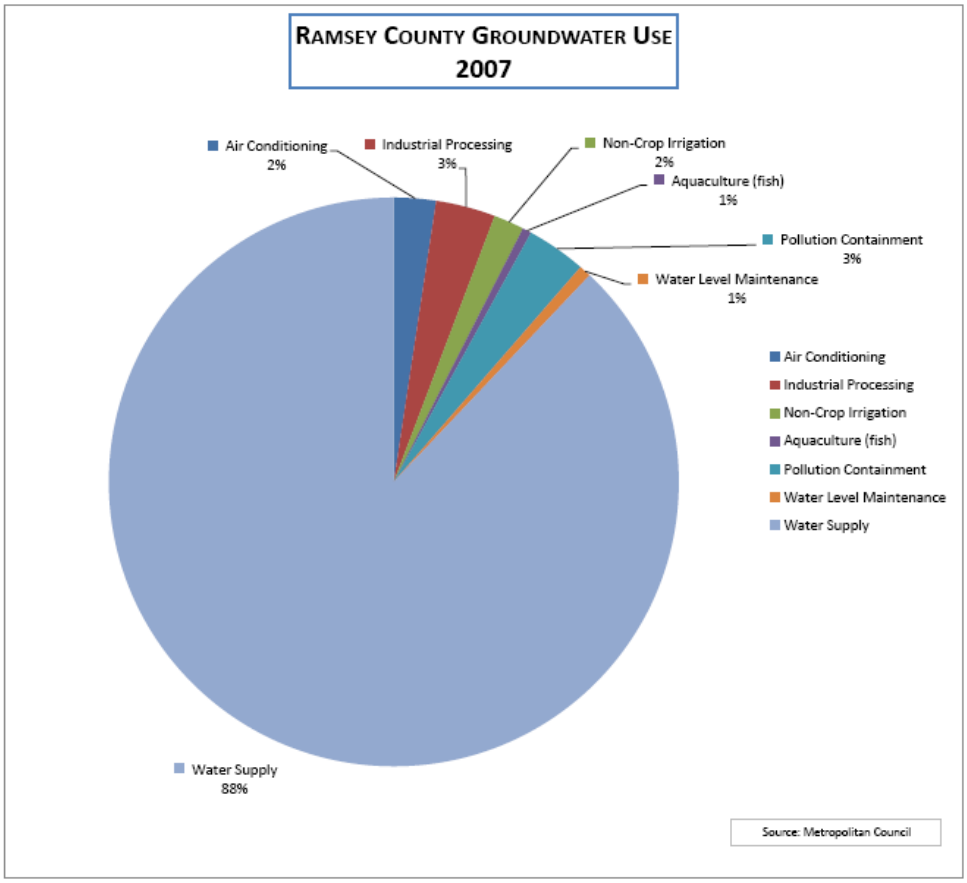


Figure 2-2 Ramsey County Groundwater Use

Certain land use activities and hazardous substances threaten the quality of groundwater resources in Ramsey County. Aquifers cannot prevent themselves from becoming contaminated and cleaning-up contaminated groundwater is an arduous and expensive process. We cannot rely solely upon other agencies (federal programs, state agencies, owners of contamination sources) to control the activities and land uses which cause groundwater contamination. Local

governments must assist in the protection of our groundwater. A well coordinated plan, with designated priorities, can help to enact reasonable measures that prevent groundwater contamination.

To cite an example, per the Ramsey County Hazardous Waste Ordinance, the Solid and Hazardous Waste Compliance Unit of the Saint Paul – Ramsey County Department of Public Health regulates as hazardous waste generators ten industrial metal plating companies that are users of solvents such as trichloroethene (TCE). TCE is a solvent that is carcinogenic and especially mobile in groundwater. Figure 2-3 shows that two of the plating companies are within the boundaries of existing municipal Drinking Water Supply Management Areas (DWSMAs). These DWSMAs show the areas from which the wells will draw water over a 10-year period. This example emphasizes the importance of ensuring compliance with hazardous waste regulations to prevent potential releases of hazardous waste at such facilities into the environment and potentially into groundwater. It also demonstrates how land use decisions could affect groundwater quality.

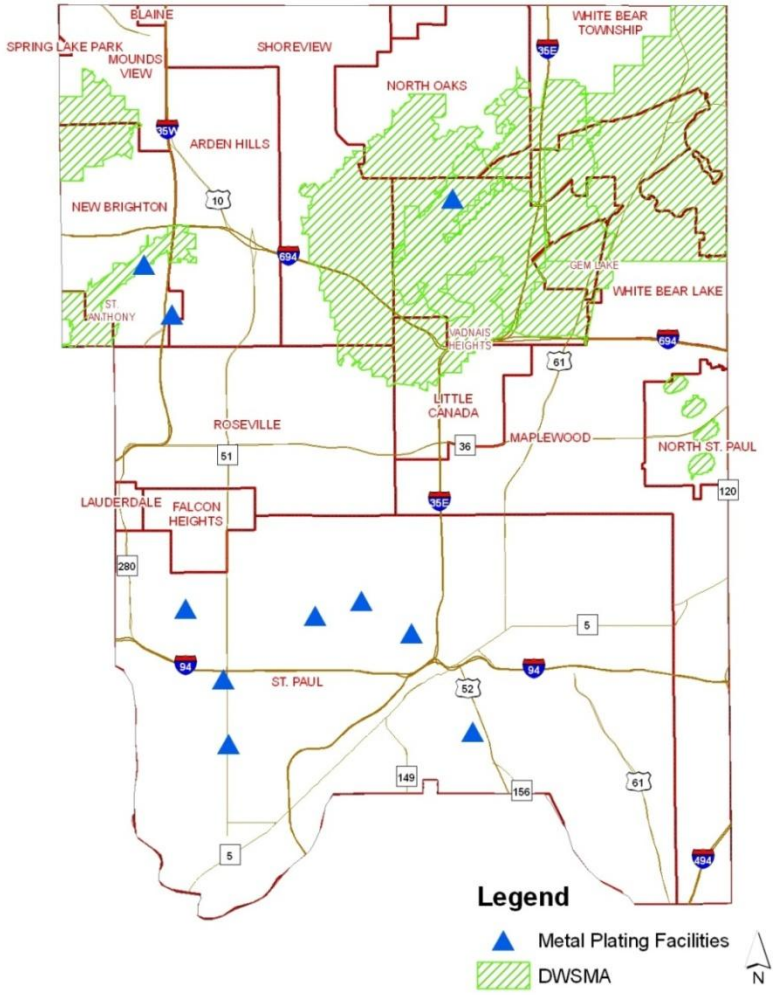


Figure 2-3 Metal plating facilities' locations compared to DWSMA

Current or potential groundwater contamination could affect the health of our residents, the future viability of our local economy, and our ability to maintain the quality of life in our communities in Ramsey County. The concern among residents, water suppliers and local governments about the quality of their drinking water and their environment is evident. It is possible and necessary for local governments to simultaneously protect groundwater from contamination and improve our quality of life without adding unreasonable burdens on local government, businesses and citizens. If we wish to have healthy and productive communities now and into the future, we must establish effective and efficient protection programs before costly contamination problems arise. An initiative to address this type of situation is included in Chapter 5.

2.3 GROUNDWATER CONTAMINATION: CURRENT AND POTENTIAL IMPACTS

The urbanized nature of Ramsey County and its associated land use characteristics have led to many groundwater contamination incidents that have affected our urban and suburban centers (see examples below). Groundwater contamination is associated with a variety of public health, economic, political, legal and environmental consequences. Significant burdens are placed upon the parties responsible for groundwater contamination and the neighboring businesses, residents, and governments of communities affected by a contamination incident. Economic impacts can occur in any community regardless of the type, amount, and extent of groundwater use.

Numerous land use activities and contamination sources threaten the quality of our groundwater resources. A search of federal, state and local databases indicates that upwards of 10,000 existing and potential contamination sources exist within our borders. The threat that sources of contamination pose varies with their type, duration, intensity, proximity to water wells and sensitive groundwater areas, and whether sources are effectively monitored and/or regulated. A concerted effort is necessary to ensure these sources do not pollute our groundwater. Figure 2-4 was compiled by the MPCA and shows sites of regulatory interest by category. Many sites are clustered along the proposed Central Corridor Light Rail Transit area.

The MPCA information includes eighty (80) unpermitted former dumps located in Ramsey County. These dumps are shown in red on the map. A separate figure and a list of these dumps are included in Appendix B. Only two sites, Fish Hatchery Dump and Pigs Eye Landfill, have been field investigated for groundwater contamination by the MPCA. One dump, the Pigs Eye Landfill, was found to have perfluorochemical (PFC) contamination impacts to groundwater. The other 78 dumps only had desktop analyses performed by the MPCA to assess the likelihood of groundwater contamination.

The Saint Paul - Ramsey County Department of Public Health has maintained an inventory since the 1980s of closed dump sites in Ramsey County, and has field verified locations and to the best of its ability characterized the wastes in those dumps. That list is also included in Appendix B. The majority of those dumps are demolition debris or brush. Many of the more significant sites that accepted mixed municipal solid waste have been assessed by the MPCA, and several have been investigated for cleanup. Some sites may need further investigation to determine if they pose a risk to groundwater, specifically drinking water supplies. One of the Plan's proposed initiatives outlines how this issue should be addressed.

The Drinking Water Supply Management Areas (DWSMAs) are shown in Figure 2-4 with sites of regulatory interest. One of the proposed initiatives will focus on supporting the creation by the Metropolitan Council of a comprehensive map showing areas of soil and groundwater contamination that could be used to make land use planning decisions.

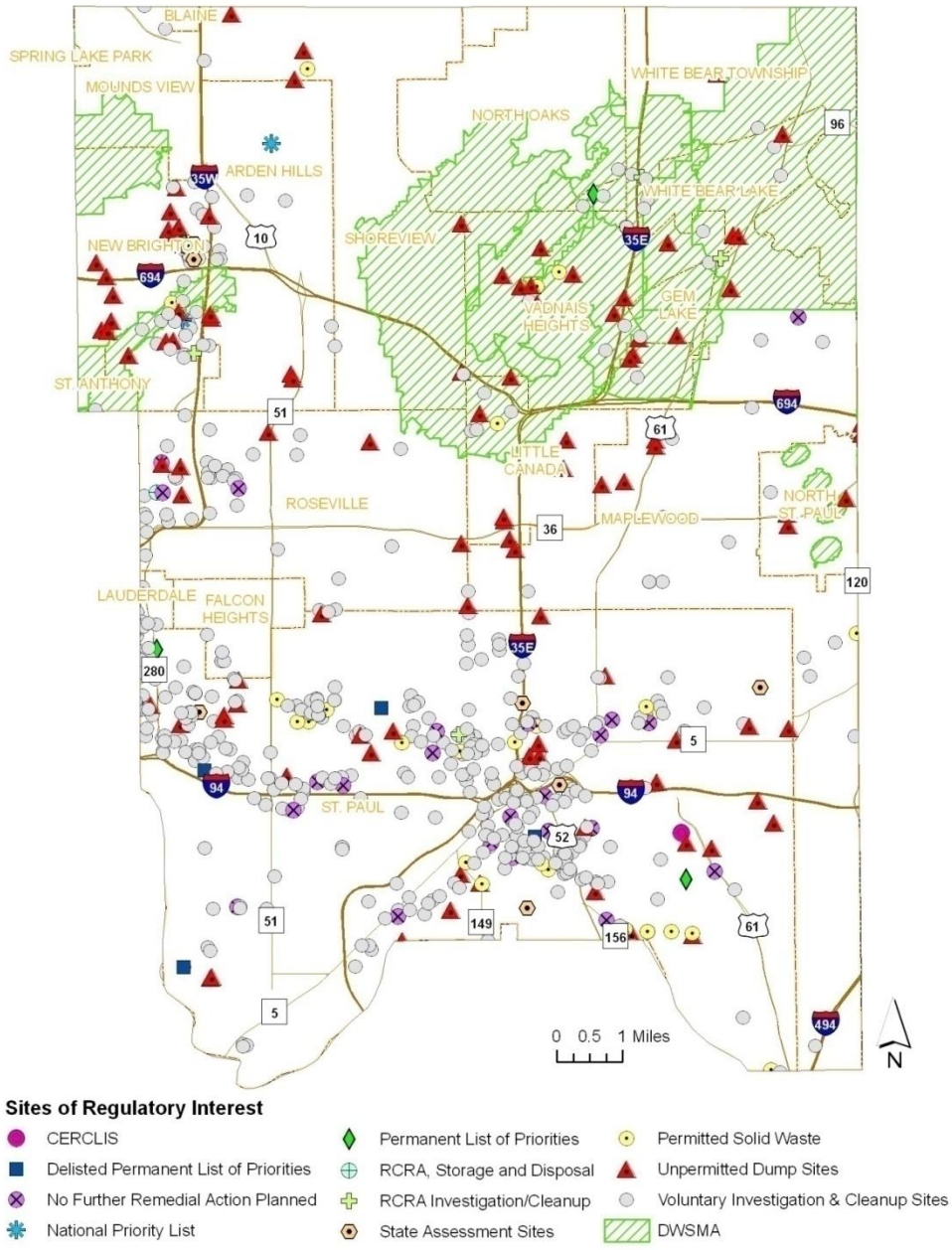


Figure 2-4 Sites of regulatory interest
(See List of Acronyms)

Groundwater contamination has negatively impacted many communities and companies throughout the state and within Ramsey County. A report by the Freshwater Foundation indicates that in Minnesota a combined 35 cities and companies have experienced costs upwards of $67 million dollars due to the pollution of groundwater. The following are just three examples which briefly describe the impacts of groundwater contamination experienced by communities in Ramsey County.

EXAMPLE - City of New Brighton: The residents of New Brighton rely on groundwater as their sole water source. In the early 1980's, volatile organic compounds (VOCs), which are carcinogenic, were detected in the city's water supply far above health limits for drinking water supplies. As a result, the city had to install several new municipal wells and a treatment system with capital costs that approached $10.5 million and annual costs over the period from 1992 – 2005 averaged $1.2 million, in order to ensure its residents a safe water supply. More money was expended by the city in legal battles. Without expensive treatment, the Prairie du Chien-Jordan Aquifer in this area of Ramsey County is now unusable as a supply of drinking water (see yellow area on Figure 2-5). The city of St. Anthony shares a similar story and costs. In both cases, third-parties were held accountable for cleanup costs.

The contamination originated from the Twin Cities Army Ammunition Plant in Arden Hills. Contamination from this site has also impacted municipal water wells in St. Anthony and possibly in Fridley. A surprising fact is that the contaminated wells are at a distance of almost one mile or more from the initial site of the contamination. It is estimated that the contaminated aquifer in the area will take at least fifty years to clean-up. This site is an example why cooperation between individual communities is needed to monitor potential pollution sources and to help protect groundwater supplies. Three other groundwater plumes are also shown; the Highway 96 Dump Superfund site, the 3M perfluorochemical releases, and the MacGillis & Gibbs Plant (wood treatment) site.

EXAMPLE - Long Lake (New Brighton) Trichloroethene Contamination:
The Minnesota Pollution Control Agency (MPCA) requested that the Minnesota Department of Health (MDH) review chemical contamination found in Long Lake, in northwest Ramsey County. Surface water trichloroethylene (TCE) concentrations in the southern lobe of Long Lake have averaged around 1 microgram per liter (µg/L) or part per billion during the summer months in recent years. TCE is a volatile organic compound and classified as a carcinogen. A swimming beach at Long Lake Regional Park raised possibility of inhalation exposure during swimming.

Historically, there have been industrial properties east of the lake, such as a refinery, a solvent company, and an ammunition plant. In general, groundwater flow is from the northeast. This would allow contaminants to flow toward the lake. Rice Creek flows through the lake as well.

Initial surface water sampling for VOCs in Long Lake took place in 1986 as part of a Ramsey County assessment of contamination from industries east of the Lake. TCE was found in samples taken from the area of the beach at 7 µg/L and 12 µg/L. The most recent round of sampling at the beach in 2005 showed TCE at 0.7 µg/L. Maintaining these concentrations over the course of 20 years, indicates a "large and constant source". While the highest measured contamination has been found in the area of the beach, no source discharge area has been identified. It is unlikely that individuals would incur any health risk from contaminants in the lake because surface water concentrations are considerably below concentrations of concern.

Additional work was recommended to find the source of the contamination. This example shows the close relationship between groundwater and surface water. Over time, contaminated

groundwater can move to the surface with unanticipated results. Countywide leadership is needed to maintain a sustainable groundwater program.

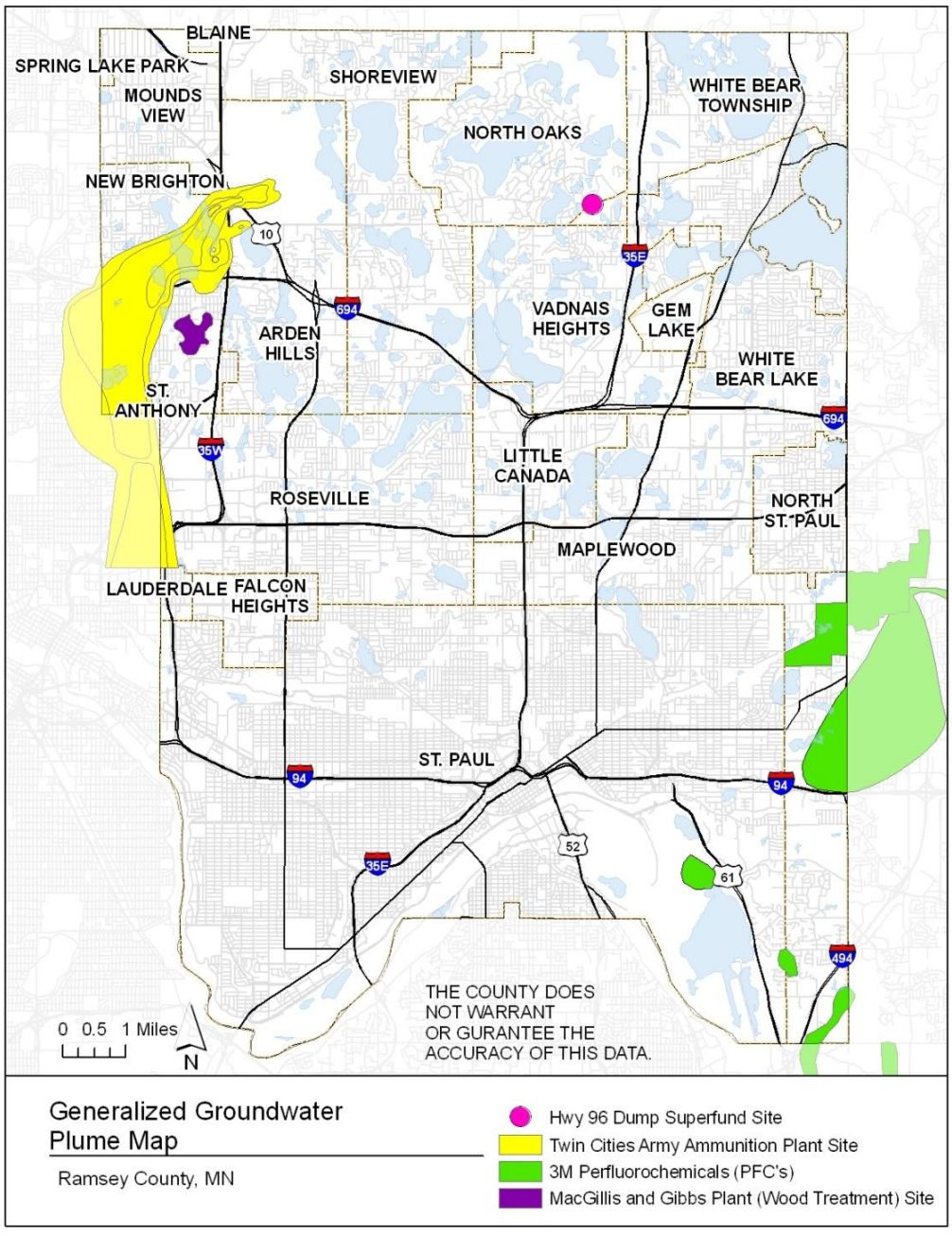


Figure 2-5 Major groundwater plumes
(Used with permission of the Star Tribune, from the series "The Longest Cleanup," Sept. 16-18, 2007; reported by David Shaffer, graphics by Billy Steve Clayton, ©2007 Star Tribune.)

EXAMPLE - North Oaks Homeowners: In 1986, it was discovered that an unpermitted open dump near Highway 96 in White Bear Township had caused contamination of the underlying groundwater (see pink dot on Figure 2-5). The groundwater contamination migrated (flowed) in a generally westward direction beneath North Oaks and impacted residential water supply wells. To date, 14 homes have been issued well advisories for potentially unsafe water by the Minnesota Department of Health. These homes have been provided an alternate source of water supply, paid for by the parties responsible for the contamination. Other homes have periodically had detections of contamination.

While a groundwater extraction system was installed near the dump, the residual contamination that was beyond the capture of the system continues to persist and it is unclear how many other homes could be impacted in the future. Thus, some of the residents of North Oaks, as well as the City, continue to spend time and resources dealing with the problems resulting from the groundwater contamination caused by an off-site source.

Effects on public health, economic growth, and clean water supplies are just a few of the many factors which indicate the need for local groundwater protection activities. Outlined below is a listing of potential consequences of groundwater contamination:

- Tax revenue spent cleaning up contamination sites, developing alternative water supplies, and paying legal fees.
- Increases in utility rates, property taxes, and other tax sources to offset costs of clean-up, installation of new water systems, and litigation.
- Residents unable to sell property due to contaminated wells.
- Concerned residents forced to use bottled water sources due to lack of clean water.
- Increased expenses for private businesses responsible for contamination clean-up.
- Image of communities and businesses tarnished due to contamination.
- Burden local government with ownership of contaminated properties following tax forfeiture.
- Reduced development opportunities due to the presence of contamination.

2.4 EMERGING GROUNDWATER ISSUES

2.4.1 Perfluorochemicals

Since the original Groundwater Protection Plan was finalized in 1996, perfluorochemicals (PFCs) have been found in Washington and Ramsey counties (see Figure 2-5 and 2-6). PFCs are a family of manmade chemicals that have been used for decades to make products that resist heat, oil, stains, grease and water. Common uses include non-stick cookware, stain-resistant carpets and fabrics, as components of fire-fighting foam, and other industrial applications.

Some of the chemicals in the PFC group are perfluorooctane sulfonate (PFOS; $C_8F_{17}SO_3$), perfluorooctanoic acid (PFOA; $C_8F_{15}O_2H$), and perfluorobutanoic acid (PFBA; $C_4F_7O_2H$). The chemical structures of PFCs make them extremely resistant to breakdown in the environment.

The PFC family of chemicals is relatively new to the environment and is the focus of active scientific research. In laboratory animal studies, high concentrations of PFCs cause harmful changes in the liver and other organs. Developmental problems (e.g., delays in growth and maturation) have been seen in the offspring of rats and mice exposed to PFCs while pregnant. Both PFOA and PFOS in high concentrations over a long period of time also cause cancer in laboratory animals. PFBA is not suspected of causing cancer in animals.

There are not many studies of health effects in people. Studies by 3M of workers exposed to PFCs during manufacturing show no apparent impact on their health. There is no similar health study information for the general population, although a study of 70,000 people exposed to PFOA in drinking water in Ohio and West Virginia is underway. The Minnesota Department of Health (MDH) continually reviews ongoing research on PFCs to ensure that their guidelines reduce exposures and protect public health.

The MDH is responsible for ensuring safe drinking water for all Minnesotans. One way MDH does this is through regular testing of public water supplies for contaminants. MDH also investigates situations where groundwater contaminants may affect private wells. Because PFCs are known to be in the environment here in Minnesota, the MDH has developed drinking water criteria, known as Health Risk Limits (HRLs), for PFOA and PFOS. HRLs are criteria that MDH considers safe for human consumption over a lifetime. In August 2007, MDH enacted a rule with HRLs for PFOA and PFOS of 0.5 micrograms per liter (ug/L) and 0.3 ug/L, respectively, under emergency rule making authority granted by the Minnesota Legislature. In February 2008, MDH issued a Health Based Value (HBV) for PFBA of 7 ug/L based on studies conducted over the previous year. An HBV is similar to an HRL, but has not been formally enacted through rulemaking.

Much more information on PFCs can be found at the MDH's website:
http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/index.html.

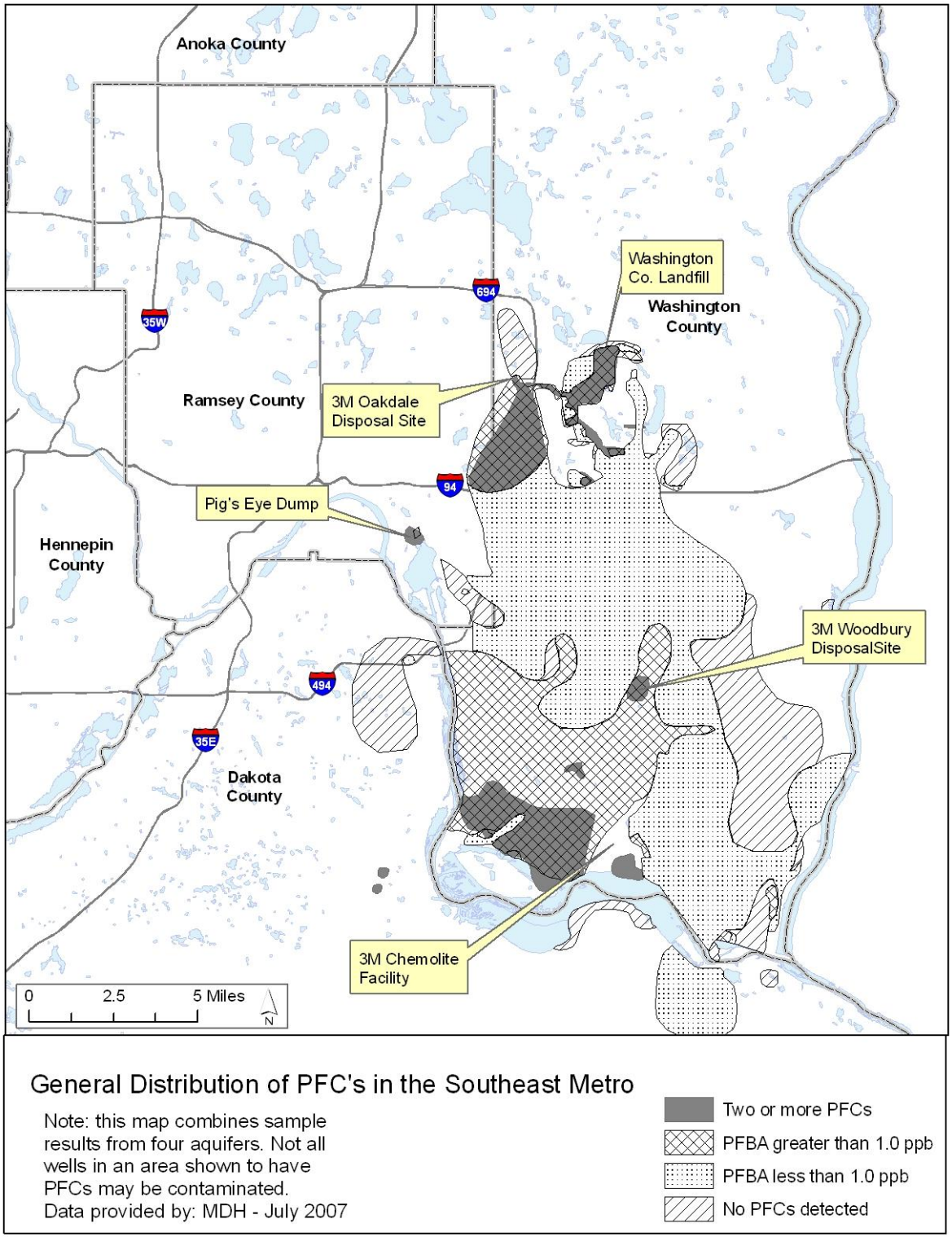


Figure 2-6 PFCs in southeast metropolitan area
(Source: Minnesota Department of Health)

2.4.2 Pharmaceutical Compounds in Groundwater and Surface Water

According to the MPCA, expired or unwanted prescription or over-the-counter medications from households have traditionally been disposed of by flushing them down the toilet or a drain. Wastewater treatment facilities are not designed to remove these compounds. Although this method of disposal prevents immediate accidental ingestion, it can cause pollution in wastewater, which has been demonstrated to cause adverse effects to fish and other aquatic wildlife. When the water is eventually reused, it can also cause unintentional human exposure to chemicals in medications.

Due to the connection between surface water and groundwater, the presence of pharmaceutical compounds in water is cause for concern.

The MPCA recommends the following disposal practice for pharmaceuticals:

Your unwanted medications may be disposed of in your trash. Follow these precautions to prevent accidental or intentional ingestion.

1. **Keep the medication in its original container**. The labels may contain safety information and the caps are typically childproof. Leaving the content information clearly visible, scratch the patient's name out or cover it over with permanent maker.

2. **Modify the contents to discourage consumption**.
    - **Solid medications**: add a small amount of water to pills or capsules to at least partially dissolve them.
    - **Liquid medications**: add enough table salt, flour, charcoal, or nontoxic powdered spice, such as turmeric or mustard to make a pungent, unsightly mixture that discourages anyone from eating it.
    - **Blister packs**: wrap packages containing pills in multiple layers of opaque tape like duct tape.
3. **Seal and conceal.** Tape the medication container lid shut with packing or duct tape and put it inside a non-transparent bag or container such as an empty yogurt or margarine tub to ensure that the contents cannot be seen.
4. **Discard the container in your garbage can**—do **not** place in the recycling bin. Do not conceal medicines in food products because they could be inadvertently consumed by wildlife scavengers.

Managing other types of pharmaceutical waste:

Unused ampoules, vials, and IV bags should not be opened (other than to scratch out the patient's name). Wrap the container with tape to minimize breakage, then place in an opaque plastic container (such as an empty yogurt or margarine tub).

Wrap the outside of the container or bag with additional duct or shipping tape to prevent leakage and further obscure the contents. Dispose of the container in the trash.

Chemotherapy drugs may require special handling. Work with your healthcare provider on proper disposal options for this type of medication.

2.4.3 Water Supply Well Interference

Municipal drinking water well interference could emerge as an issue in Ramsey County if factors like drought conditions and intensive water use coincide. The DNR is the regulatory agency with the authority to settle conflicting uses of a drinking water aquifer where one well is running another well dry. These issues can arise between municipal, private uses, irrigation, and domestic wells. According to the DNR, most notable of these is interference between domestic and municipal uses. Most domestic users, including all residents of North Oaks on private wells, have appropriations less than the amount requiring a DNR permit.

As background, when a high capacity well is pumping, a portion of the aquifer around it is dewatered in a pattern known as a "cone of depression". Wells located within the cone of depression may experience lower water levels and have problems producing water if water levels are lower than the well pump. This condition is referred to as "well interference". Most well interference problems tend to be localized and short in duration, but being without water is a major inconvenience and can cause damage to well pumps. Some problems can be resolved by lowering the pump in the affected well or installing a new well pump, but in some situations it may be necessary to construct a new water supply well. The concept of "conflicting use" has a statutory definition and is addressed in Minnesota Rule 6115.0740; Water Use Conflicts.

Well interference is considered by the Minnesota Department of Natural Resources (DNR) in two sets of circumstances:

- before a DNR appropriation permit is granted to a new well and
- when an interference complaint is registered with the DNR.

The DNR's analysis is thorough, sophisticated, and allows for local review. Minnesota Statutes allow local units of government 30 days to review projects and submit comments to the DNR. The Ramsey Conservation District, watershed district, and the affected city would all have the opportunity to comment. In addition, the DNR has expressed the hope that the proposed Ramsey County Groundwater Partnership be involved in drought response planning. The current 2009 Minnesota Drought Response Plan can be found on the DNR's website at: http://files.dnr.state.mn.us/natural_resources/climate/drought/drought_plan_matrix.pdf .

If the DNR determines a well interference condition exists, the permitee will be required to perform one or more of the following actions within 30 days of notification:

- request a modification or restriction of the permit in order to provide the affected well owner with an adequate domestic water supply.

- negotiate a reasonable agreement with the affected domestic well owner(s).
- request a public hearing.

Questions related to well interference can be directed to the Ramsey Conservation District, 651-266-7270.

2.5 SURFACE WATER-GROUNDWATER INTERACTION

There are many links between surface water and groundwater. Precipitation in Ramsey County falls onto the land, where it flows over the ground as surface runoff. Some runoff enters streams and rivers. Runoff and groundwater seepage accumulate and are stored as freshwater in lakes. Not all runoff flows into rivers. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers (saturated subsurface soil and rock), which store vast amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep into lakes, streams, wetlands, and springs as groundwater discharge.

Contaminated surface water can pollute groundwater as stormwater infiltrating through contaminated soil mobilizes those chemicals and degrades groundwater quality. Groundwater appropriations can, under certain circumstances, have an impact on groundwater elevation in sensitive areas. Groundwater protection initiatives in this Plan will focus on making sure infiltration efforts, so important to reducing stormwater discharge volumes to 1988 quantities in order to meet non-degradation standards, under Municipal Separate Stormwater System (MS4) requirements, do not result in unintended groundwater contamination.

2.6 LOCAL RESPONSIBILITY FOR PROTECTING GROUNDWATER

Groundwater contamination is a local problem. Water supplies are provided locally either by a well owned by a homeowner, community, business or a local unit of government. Contamination sources in Ramsey County are within a short vertical distance of the aquifers which they can potentially impact. A program for protecting groundwater is necessary for Ramsey County. The roles of various environmental agencies are fully defined in a Freshwater Society document called "*Water Resources Management in Minnesota*" and it is included in Appendix A.

There is no regulatory agency which fully coordinates state, federal and local policies relating to groundwater protection. Regulatory strategies which address protection issues are either reactive in nature, too underdeveloped to fully protect the resource, or non-existent. A void exists that calls for additional local groundwater protection.

Federal and state agencies have developed programs and regulations which relate to groundwater contamination. However, most state and federal groundwater activities are distributed among many different agencies and usually do not include meaningful local involvement.

It should be noted that Wellhead Protection Plans in Ramsey County are slowly getting completed but they only delineate where potential sources of contamination exist within Drinking Water Supply Management Areas (DWSMAs) surrounding each water supply well.

Without the help of local governments, state and federal programs cannot fully address local groundwater protection needs. The time has arrived for coordinating a comprehensive county

groundwater protection strategy that gives countywide groundwater protection responsibility to a county organization.

Ultimately, everyone should share the responsibility for protecting groundwater. The groundwater plan emphasizes a cooperative protection approach between citizens, cities, county services, watershed organizations and state agencies. This report recognizes the importance of promoting an ethic and structure of land and water stewardship and recognizes that effective measures are necessary to protect our drinking water as an important economic resource.

The current emphasis on resource planning, reporting, and contamination cleanup are part of the process but they are different than groundwater protection. By taking a few small regulatory steps, Ramsey County will take the lead on the prevention and early detection of groundwater threats.

3.0 Groundwater Planning Overview

3.1 GROUNDWATER PLAN REQUIREMENTS

According to Minnesota Statute 103B.255, a groundwater protection plan must:

- cover the entire area within the county;
- describe existing and expected changes to the physical environment, land use, and development in the county;
- summarize available information about the groundwater and related resources in the county, including existing and potential distribution, availability, quality, and use;
- state the goals, objectives, scope, and priorities of groundwater protection in the county;
- contain standards, criteria, and guidelines for the protection of groundwater from pollution and for various types of land uses in environmentally sensitive areas, critical areas, or previously contaminated areas;
- describe relationships and possible conflicts between the groundwater plan and the plans of other counties, local government units, and watershed management organizations in the affected groundwater system;
- set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government; and
- include procedures and timelines for amending the groundwater plan.

3.2 PLANNING PROCESS

The planning process for the development of the revised Ramsey County Groundwater Protection Plan began in the summer of 2008. As directed by state statute, a Technical Advisory Committee (TAC) and a Local Advisory Committee (LAC) were formed. The TACs responsibility was to provide advice, recommendations, and public input concerning the development, content, and implementation of the Plan. The eighteen members of the TAC are listed in the Executive Summary and they represent a variety of interests: cities, water organizations, county departments, state and regional agencies, and well drillers.

3.3 PLAN STRUCTURE

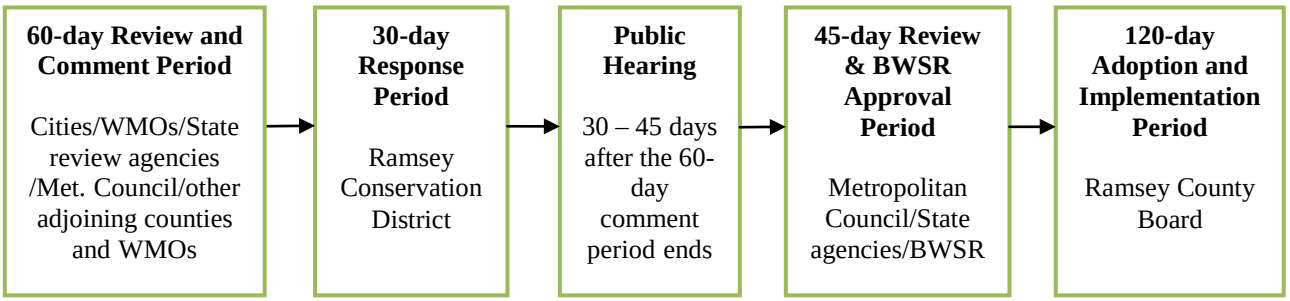
The need for protecting groundwater is outlined in "Why Protect Groundwater?" A groundwater planning process overview is presented here in Chapter 3. An assessment of the groundwater resource is covered in Chapter 4. The initiatives endorsed in this Plan are included in Chapter 5.

Due to our unique countywide mandate and focus on groundwater, Ramsey Conservation District is listed as the leader of several initiatives proposed in this Plan.

3.4 PLAN REVIEW, ADOPTION, AND AMENDMENT

The groundwater planning statute has established standards for the review, adoption and amendment of the groundwater plan. Upon completion of the plan, but before county adoption, the plan must go through an extensive review process by local and state government units. Refer to subdivisions 8 through 10 of statute 103B.255 for a full explanation of statutory procedures. A review and adoption timeline is presented below.

3.4.1 Plan Review Timeline



3.4.2 60-day Review

The plan will be submitted for 60-day review to the following entities:

- Ramsey County Board and related county departments,
- Townships,
- Statutory and home rule charter cities,
- Watershed management organizations (WMOs),
- Other WMOs and counties residing within the groundwater system that could affect or be affected by the implementation of the plan.
- St. Paul Regional Water Services
- Metropolitan Council,
- Department of Natural Resources,
- Minnesota Pollution Control Agency,
- Minnesota Department of Health, and
- Board of Soil & Water Resources

Review agencies have 60 days to review and comment. Differences between local governments regarding the plan must be mediated. Within their review comments, any political subdivision that expects substantial amendment of its plans may be needed to conform with the groundwater plan, must describe as specifically as possible the necessary amendments to their plans along with their plan amendment and implementation costs. RCD will then have a 30-day response period, followed by a public hearing.

3.4.3 45-day Review

After the 60-day review process, the plan and local review comments must be submitted to the Metropolitan Council, state agencies, and BWSR for review. Statute 103B.255, states that these agencies have 45 days to review the Plan.

The Board of Soil & Water Resources (BWSR) must review the Plan according to Minnesota Statutes 103D.401 and 103D.405 to ensure the plan is in conformance with the requirements of Minnesota Statutes 103B.205 to 103B.255. BWSR can disapprove of all or parts of a plan if it is found not to be in conformance.

3.4.4 Plan Adoption

Within 120 days after approval of the groundwater plan by BWSR, the county shall consider adoption and implementation the Groundwater Protection Plan.

If the Plan is adopted, municipalities, watershed management organizations, and Ramsey County departments (Environmental Health) may have to adjust their policies and regulations to conform to the new Plan. Following approval, implementation of the Plan's requirements will require time and effort of the District's Groundwater specialist and other RCD staff.

3.4.5 Plan Amendment

After adoption of the groundwater plan, it should be reviewed every five years. The members of the proposed Ramsey County Groundwater Partnership and/or other agencies involved in Plan implementation will have final decision authority in matters related to Plan amendment. If necessary and/or requested by the agencies involved in plan implementation, plan amendments will be made. All amendments will follow the same review and comment process stipulated in Minnesota Statutes Chapter 103B.255, Subdivisions 8 to 10.

3.4.6 Annual and Ongoing Reporting

Ramsey Conservation District will include the input and concerns of the proposed Ramsey County Groundwater Partnership. An annual report will be submitted to the Partners and Ramsey County Board of Commissioners detailing yearly progress and developments in the implementation of the Groundwater Protection Plan, as well as a work plan for the upcoming year.

Ongoing reporting will also be provided to funding Partners in forms suitable to their needs.

4.0 Groundwater Resource Overview

Groundwater serves as the sole source of drinking water for approximately 20% of Ramsey County's residents. Virtually all of the residents not supplied with water by the St. Paul Regional Water Services are dependent on groundwater. This means that most of the north half of Ramsey County depends on groundwater for its water needs.

St. Paul Regional Water Services also depends on groundwater to supply approximately 7% of its water needs. Groundwater is also vital for maintaining water flow and water quality in many streams, rivers, and lakes.

Groundwater is susceptible to contamination from land uses not only in Ramsey County, but also in areas outside the county where rainfall recharges the aquifers we use here. This chapter of the Groundwater Plan describes the science to address groundwater concerns that will protect this vital resource on a countywide basis.

The Metropolitan Council assesses groundwater in the metropolitan area from a sustainability perspective and the DNR has a groundwater elevation monitoring program, carried out in Ramsey County by Ramsey Conservation District. However, there is no current program that adequately monitors the water quality or water table elevations of this vital resource in Ramsey County.

4.1 GEOLOGY

Groundwater moves through many geologic formations in Ramsey County. Advancing and retreating marine seas deposited a sequence of limestone, sandstone, and shale bedrock layers dating back to the Paleozoic Era (570 – 245 million years ago). After this, the bedrock was exposed at the surface to a long period of erosion. Then, beginning about 1.5 million years ago in the Quaternary period, a sequence of glaciers advanced and melted across what is now Ramsey County shaping the land surface and depositing layers of unconsolidated clay, silt, sand, and gravel on top of the eroded bedrock formations. A more complete treatment of Ramsey County geology can be found in the Ramsey County Geologic Atlas or the 1996 Ramsey County Groundwater Protection Plan.

4.2 BEDROCK FORMATIONS

Bedrock found beneath the younger glacial deposits is composed of sandstone, shale, and limestone which are collectively referred to as sedimentary rock. These rocks are grouped into formations based on similarities of rock type and origin. Figure 4-1 shows the bedrock geology of Ramsey County. Rock formations that readily transmit water are called aquifers and formations that inhibit the flow of water are called confining layers or aquitards.

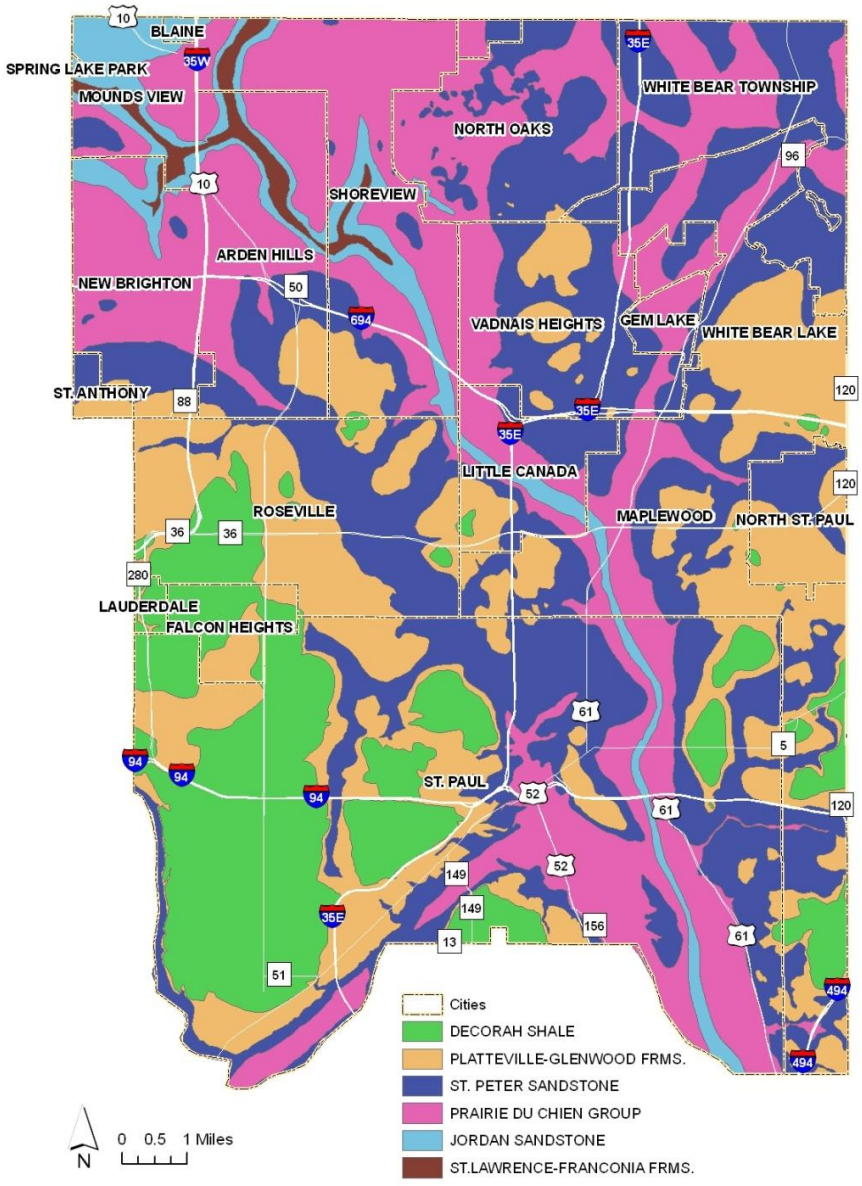


Figure 4-1 Bedrock geology
(Source: Geologic Atlas of Ramsey County, MGS)

4.3 SURFICIAL GEOLOGY

Over the past 1.5 million years (Quaternary Period), continental scale glaciers have advanced four times from the north across Ramsey County. Each time, bedrock was eroded and unconsolidated glacial sediment was deposited during the advance and retreat of the glaciers.

These glaciers were massive sheets of ice, several thousand feet thick, and advanced as snow to the north accumulated and was compressed into ice. As these slowly flowing bodies of ice moved, they transported vast quantities of clay, silt, sand, and gravel as; lake and stream sediments (as shown in Figure 4-2). All this sediment had a direct effect on our current landscape and also on the ability for stormwater to infiltrate at different locations in the County.

Rain water that falls in Ramsey County partially runs off into our streams, lakes, and wetlands, and partially percolates down through the surficial glacial materials to the water table. Stormwater infiltrates into sands and gravels faster than through silts and clays. This affects rates of groundwater recharge and the aquifer's sensitivity to pollution.

Figure 4-2 Surficial geology
(Source: Geologic Atlas of Ramsey County, MGS)

4.4 GROUNDWATER HYDROGEOLOGY

The study of the occurrence of groundwater in the earth and its movement is the primary focus of the study of hydrogeology. The hydrologic cycle is depicted in Figure 4-3.

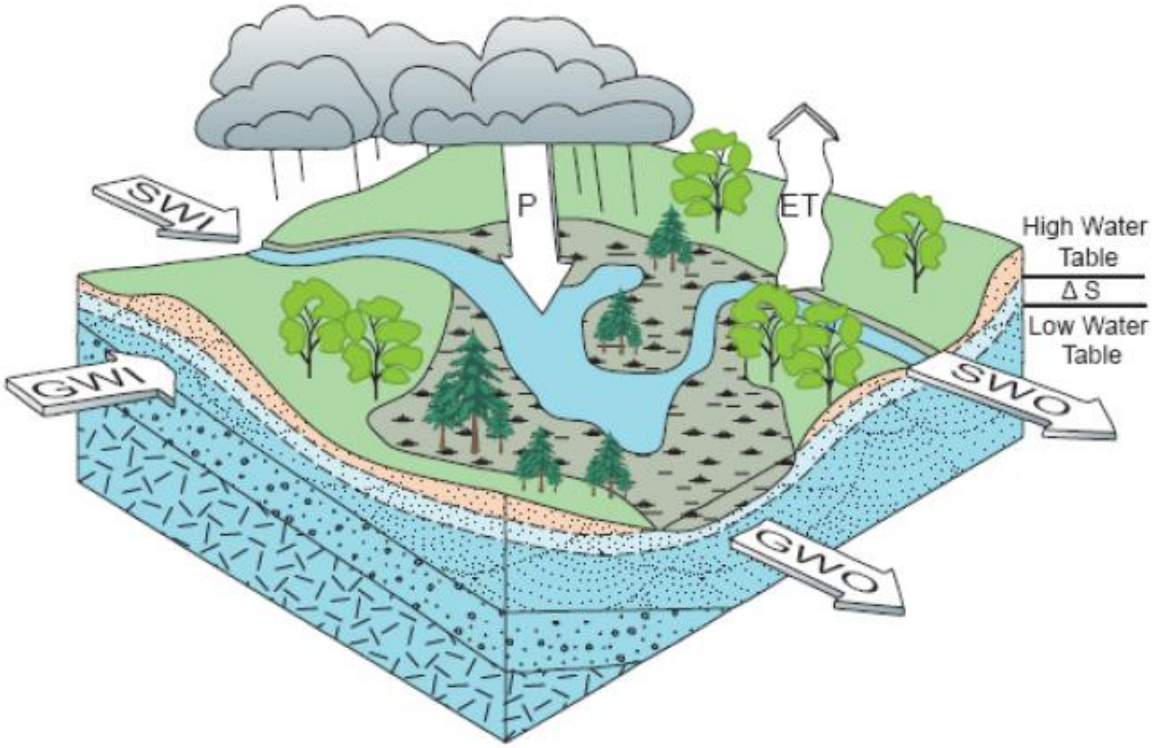


Figure 4-3 Water cycle-surface water and groundwater connection (Source: BWSR)

Precipitation (rain or snow) follows one of three paths once it falls:

- Water evaporates to atmosphere, either directly or through plants,
- Runs off to surface water bodies (streams, lakes, or wetlands), or
- Infiltrates downward into unconsolidated surficial materials or into bedrock aquifers, becoming groundwater.

Infiltration of rain into groundwater is referred to as groundwater recharge. Some groundwater discharges into springs, streams, and lakes. Water that migrates downward through geologic

materials moves more quickly through porous materials (sand and gravel) and more slowly through non-porous materials (clay). Aquifers are defined as geologic formations that transmit sufficient quantities of groundwater for human consumption. In Ramsey County, both porous unconsolidated sand and gravel glacial deposits and fractured, weathered limestone or sandstone bedrock formations act as aquifers. Table 3 categorizes the formations as aquifers or confining layers.

Table 3 - Hydrogeologic Properties of Rock Layers

Geologic Formations and Characteristics		
Rock Unit/Layer	**Hydrogeologic Property**	**Thickness (Ft.)**
Quaternary (Glacial) Deposits	Aquifer	100-500
Decorah Shale	Partial Confining Unit	0-96
Platteville Formation	Aquifer	30-33
Glenwood Formation	Partial Confining Unit	
St. Peter Sandstone	Aquifer	156-166
Shaly St. Peter Base	Partial Confining Unit	
Prairie du Chien Group Jordan Sandstone	Form a Single Aquifer	190-234
St. Lawrence Formation	Confining Unit	34-59
Franconia Formation Ironton and Galesville Sandstones	Form a Single Aquifer	158-227
Eau Claire Formation	Confining Unit	63-110
Mt. Simon Sandstone	Aquifer	250-336

4.5 GROUNDWATER RECHARGE TO WATER TABLE AQUIFERS

The quantity of groundwater recharge varies from year to year based on rainfall variation. The quantity and quality of recharge is influenced by land use activities. In urbanized areas, where a high proportion of impervious surfaces exist, groundwater recharge may be reduced. On the other hand, some evidence exists to suggest that urban areas may experience higher rates of groundwater recharge due to lowered evapotranspiration rates by urban vegetation, leaking wastewater and water infrastructure, and stormwater management infiltration strategies. If this is the case, the increased groundwater recharge potential of urban landscapes should be recognized both as a way that mitigates aquifer drawdown and as a concern for stormwater quality management. Point source and non-point source pollution can degrade water quality in areas far distant from the release. The physical geography of the County is described in Appendix D.

4.6 GROUNDWATER RECHARGE TO BEDROCK AQUIFERS

For bedrock aquifers to recharge, a pathway from the surface downward must exist. In Ramsey County, the upper bedrock aquifers (St. Peter, Prairie du Chien, and Jordan) are recharged by water from the overlying, unconsolidated sand and gravel glacial sediments. Recharge is mainly in areas of bedrock valleys where the confining layers have been eroded away. The major eroded bedrock valley (Phalen Channel) in Ramsey County extends from Mounds View to east of downtown St. Paul and is shown on Figure 4-4.

Recharge to these deeper bedrock aquifers can carry with it the pollutants that also affect the overlying unconfined aquifer. The bedrock valleys offer an entry point into the main drinking water aquifer in Ramsey County because the Decorah Shale has been removed by erosion. The primary public drinking water aquifer in Ramsey County is the Prairie du Chien-Jordan, which directly underlies the Decorah Shale, where it is present. Without the overlying Decorah Shale aquitard, the Prairie du Chien-Jordan is much more susceptible to contamination.

Deeper aquifers such as the Mt. Simon are recharged by leakage through intervening confining layers and this recharge is much slower than for the upper bedrock aquifers.

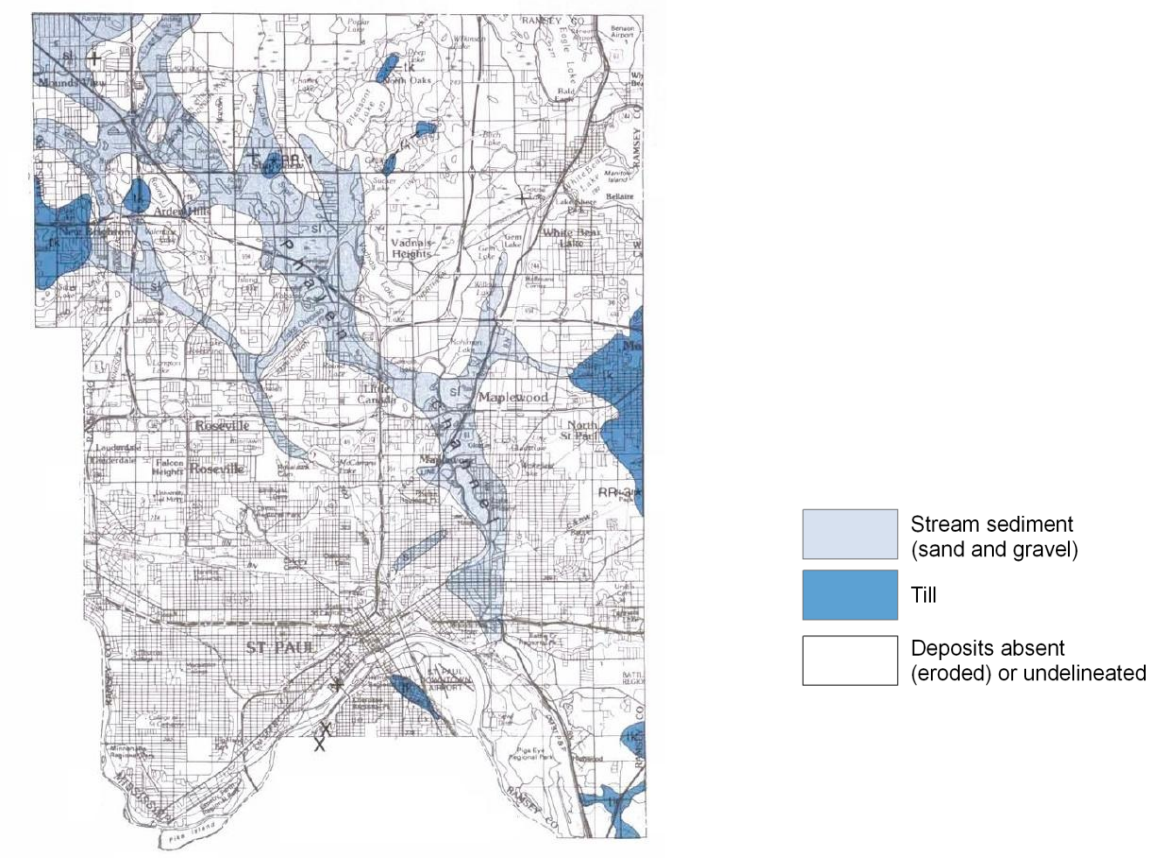


Figure 4-4 Phalen Channel – major buried bedrock valley in Ramsey County and Pre-late Wisconsinan glacial deposits (Source: Ramsey County Geologic Atlas)

4.7 PRIVATE DRINKING WATER WELLS

Private residential water wells were installed prior to cities' water service and most of these wells are idle and unused now that city water is available to virtually all county residents. Unused wells are often called "abandoned wells". A high proportion of these wells were completed in the near-surface unconfined aquifer. This leaves them more susceptible to contamination than wells in deeper aquifers. Unfortunately, there is often no information documenting construction and location of private drinking water wells.

A RCD study performed in the mid-1990s calculated that approximately 30,000 unused water wells were believed to exist in Ramsey County at that time. Some have been sealed appropriately and it is estimated that 27,000 wells currently exist (see Figure 4-5). RCD derived these well locations from two sets of data: addresses by date of a house's construction and the date the water utility installed the distribution system. A red dot was placed on the map on the assumption that a house built more than 18 months before water service was available, necessarily had to have a well.

These unused residential wells, when no longer in use, can deteriorate and allow contaminants to spread faster through the aquifer. The MDH recognizes that unused wells create a pathway for contaminants to move vertically in an aquifer. Some unused submersible pumps also pose a threat due to the presence of PCBs in electrical capacitors in some of the pumps. The MDH requires that unused wells be licensed and an annual Maintenance Permit fee paid to the MDH or they must be properly sealed.

The city of North Oaks is a municipality with a high concentration of actively used private drinking water wells and individual sewage treatment systems (ISTSs). These ISTSs are a concern because non-compliant ISTSs are threats to groundwater quality because infiltration of untreated waste could carry pathogens, excess nutrients, and emerging contaminants from certain chemical and microbial constituents that have not historically been considered as contaminants. These newly recognized contaminants represent a shift in traditional thinking as many are produced industrially yet are dispersed to the environment from domestic, commercial, and industrial uses.

Most unused wells are sealed in response to a property transaction, at a buyer's request. Depending on a variety of circumstances, sealing of unused wells in Ramsey County is currently funded partially by well owners or a handful of watershed organizations and/or cities that have well sealing cost-share programs.

According to the MDH, approximately 300 water wells are sealed annually in the County (not including environmental monitoring wells). Since most of the well sealing work is currently done in response to property transactions. At this rate, it would take 90 years to seal the existing wells. Figure 4-6 shows locations of MDH permitted private residential wells in Ramsey County. These wells were generally installed since July 15, 1974, when the MDH Well Code was adopted or after January 1, 1975, when submittal of well records was required.

Ramsey Conservation District has an existing $10,000 federal grant covers 50 percent of the matching costs for sealing approximately 20 wells outside the boundaries of St. Paul, North St. Paul, and the Capitol Region Watershed District. North St. Paul and the Capitol Region Watershed District have their own well sealing programs. An initiative in Chapter 5 of this Plan describes a program to increase the number of unused wells sealed every year. Sealing an unused residential well currently averages less than $1,000. With or without financial incentives, sealing unused wells represents a tangible effort for a property owner to protect our shared groundwater resource.

The permitted and active wells shown in Figure 4-6 could be catalogued by which aquifer they appropriate and this could be of value to identify and analyze potential supply and contamination issues. Perhaps some of these active wells and/or some inactive wells could be utilized for groundwater quality and/or quantity monitoring.

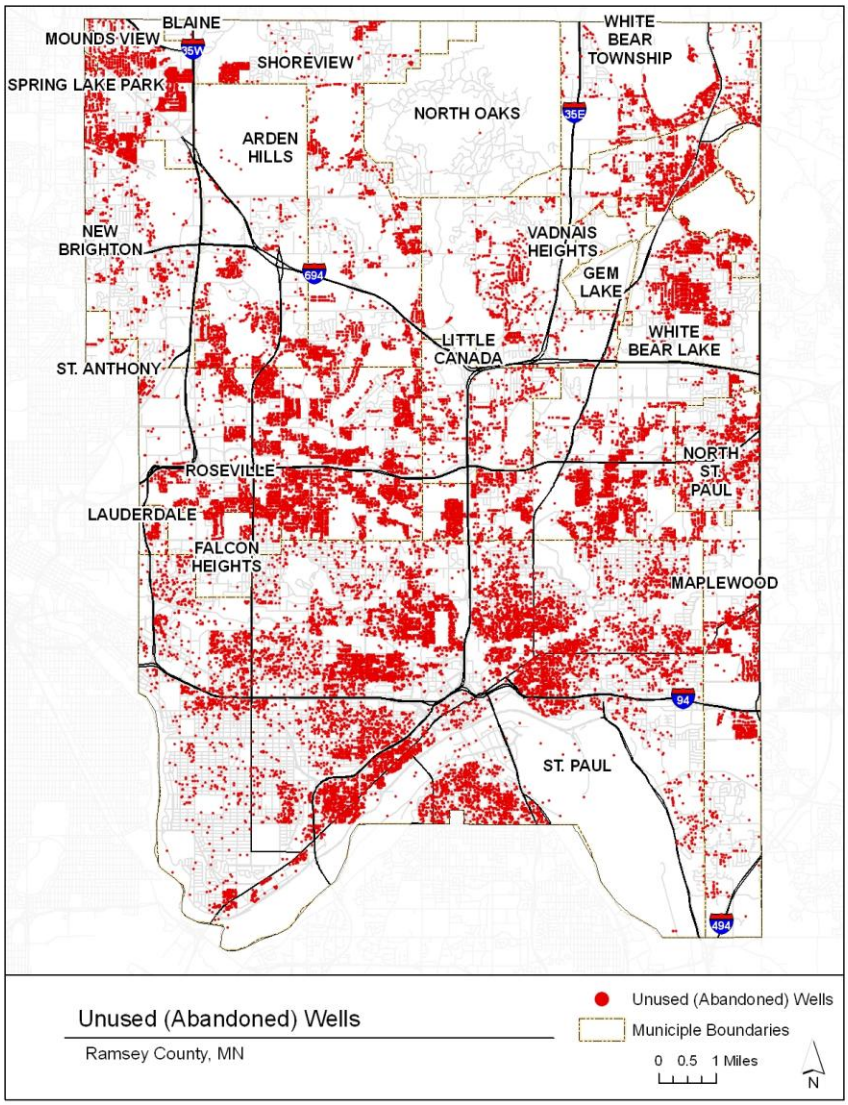


Figure 4-5 Unused (abandoned) wells in Ramsey County
(Source: RCD)

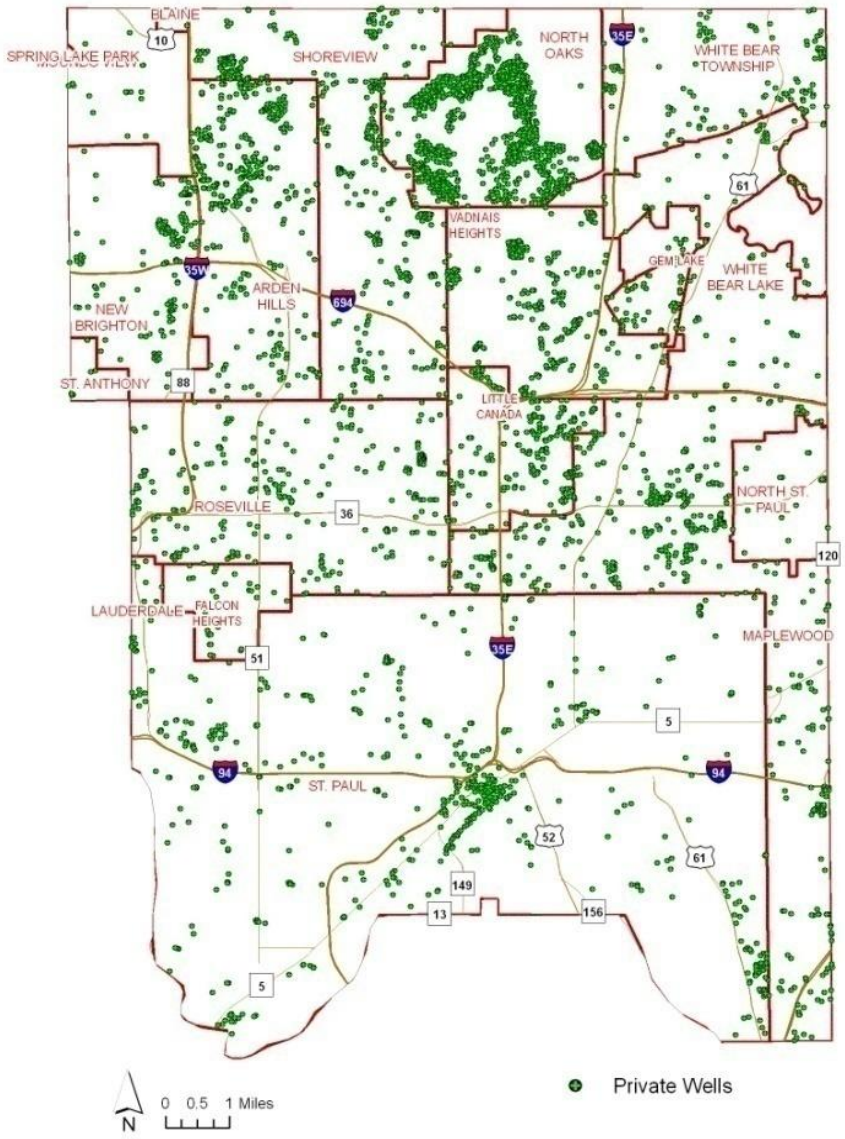


Figure 4-6 Private wells in Ramsey County with verified locations
(Source: RCD)

4.8 WATER SUPPLY WELLS

Water supply wells in Ramsey County produce water from glacial deposits, St. Peter, Prairie du Chien, Jordan, St. Lawrence, Eau Claire, Ironton and Franconia-Mt. Simon bedrock aquifers. The primary public drinking water aquifer is the Prairie du Chien-Jordan. The DNR has suggested that water supply well logs should be reexamined to determine whether the St.

Lawrence and Eau Claire formations are indeed being used as appropriation aquifers, since these formations are not generally known as aquifers.
There are 59 municipal and community non-transient water wells serving county residents (See Figure 4-7 and Appendix G). The community non-transient wells are also referred to as "community well systems".

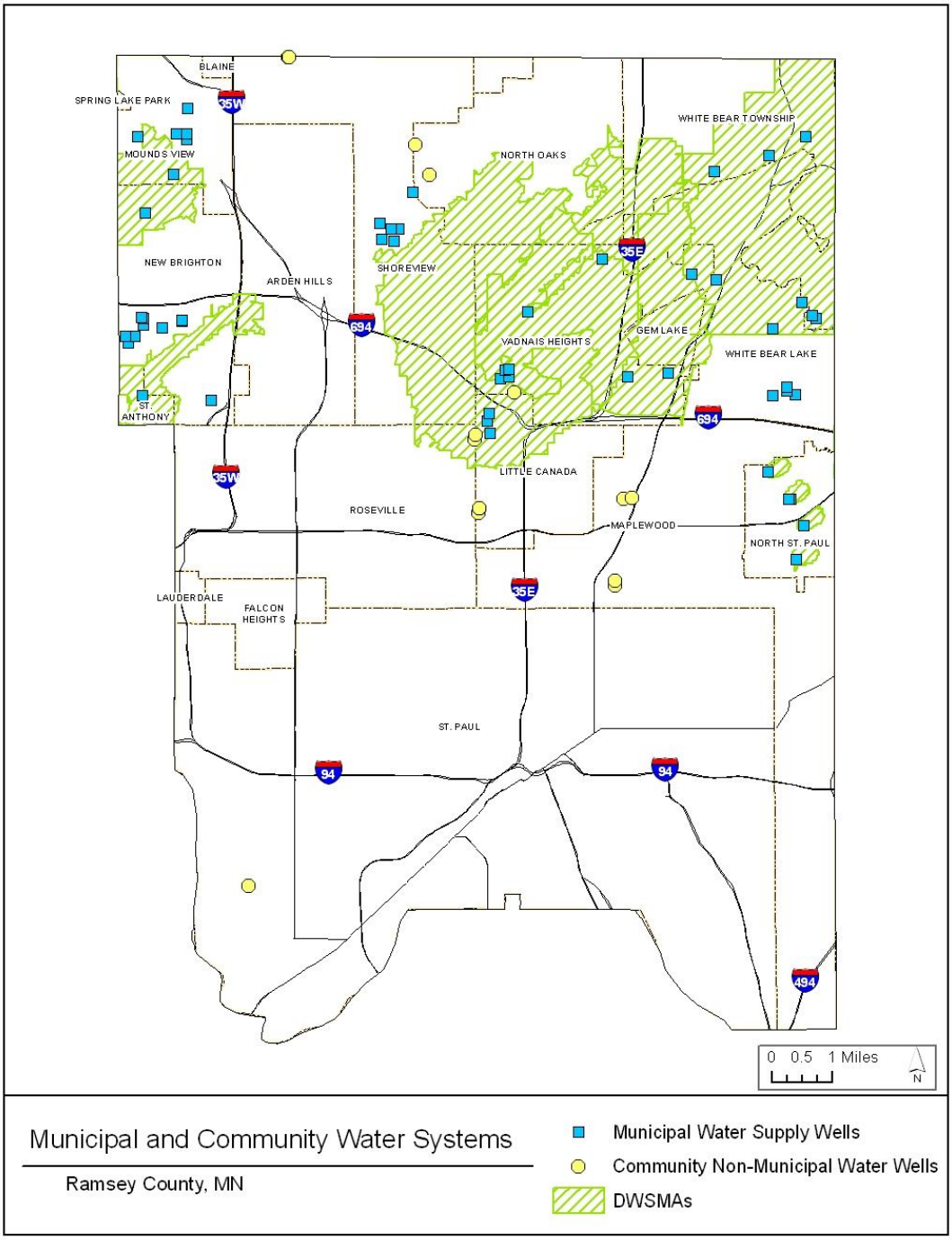


Figure 4-7 Municipal and community non-municipal well locations

(Source: RCD)

The MDH samples and tests water from these wells on a regular basis. Water reports for community water suppliers, containing water quality data, can be accessed through the websites for individual cities. Two cities, New Brighton and St. Anthony, have treatment systems for volatile organic compounds contamination.

The MDH samples "raw" or untreated water from some wells. Otherwise, "treated" water that has undergone chlorination or other processes, is collected for analysis. Only 24 city wells are sampled individually and before treatment. Water quality on the remaining 34 wells does not reflect the quality of the aquifer due to the influence of mixing water from multiple wells or due to sampling of treated water. The MDH is considering changing its sampling practices to collect well water from pre-treatment sources. The following table (Table 4) shows water supply wells sampled by the MDH.

Table 4 - Public Water Supplies Tested by the MDH

Public Water Suppliers-MDH Testing Ramsey County					
City	**Total No. Wells**	**No. Wells Tested by MDH (Individually)**	**No. Treatment Plants**	**MDH Data (pre-treatment)**	**No. Wells Without Individ. Pre-treat. Testing**
Mounds View	5	0	3	NO	5
New Brighton	11	6	4	NO	9
North St. Paul	5	5	1	YES	0
St. Anthony	2	0	1	NO	2
St. Paul Regional Water Svs.	8	-	0	NO	8
Shoreview	6	1	1	YES (Well #6 only)	5
Vadnais Heights	3	3	0	YES	0
White Bear Lake	5	0	1	NO	5
White Bear Twp.	6	6	1	YES	0
Community Non-municipal Water Wells (i.e., mobile hm. pks.)	9	9	0	YES	0
Total No. Wells:	**60**	**30**			
No. supply wells w/out individual pre-treatment well data:					**34**
Community Non-municipal wells (above):					
St. Paul Cabins	2				
Town and Country Mobile Home Park	2				
Thirty-Twenty Mobile Home Park	2				
Arden Manor Mobile Home Park	1				
Home of Good Shepherd	1				
Charley Lake Townhomes Association	1				

Currently, most municipal water quality testing is not performed on “raw”, or untreated, water. Lacking that information little can be determined about water quality. Initiatives to address

water quality sampling of municipal and community non-municipal water suppliers are included in Chapter 5.

The various types and definitions of public water systems are shown in Figure 4-8, below:

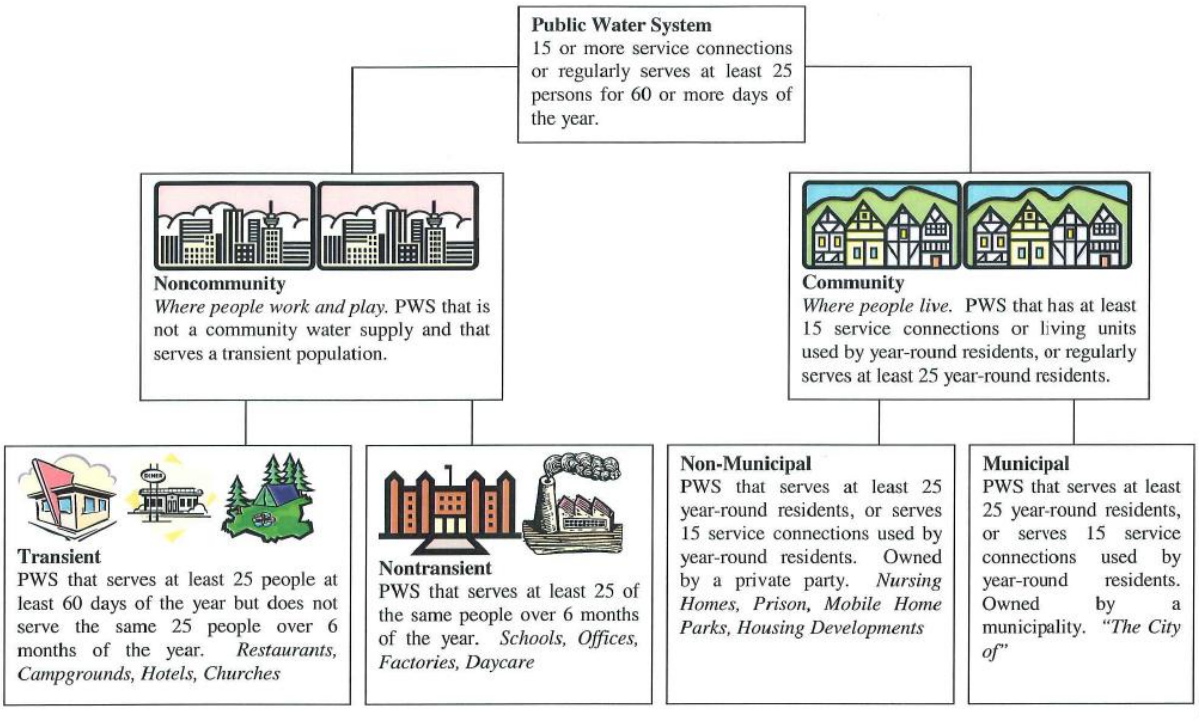


Figure 4-8 Water System Categories and Definitions
(Source: Minnesota Department of Health)

4.9 DRINKING WATER WELL VULNERABILITY

The Minnesota Geological Survey sampled groundwater from several public and private wells in Ramsey County. The samples were analyzed for tritium. Tritium is a radioactive element that, due to its' wide dispersal during the atomic bomb tests of the 1950s, is an ideal tracer material for determining the relative age of groundwater.

The analysis shows that groundwater pumped from the Prairie du Chien-Jordan aquifer is typically younger than 50 years old (See Figure 4-9). The darker gray areas show water that has recharged the aquifer in the last 50 years. This finding means that relatively young water is recharging the bedrock water aquifers and this raises the possibility that the young fraction of groundwater contamination in the shallow, unconsolidated aquifer may be pulled down into the deeper aquifer as recharge.

This connection between the unconsolidated aquifer and the primary bedrock aquifer used by most Ramsey County municipalities serves as indication of aquifer vulnerability to pollution.

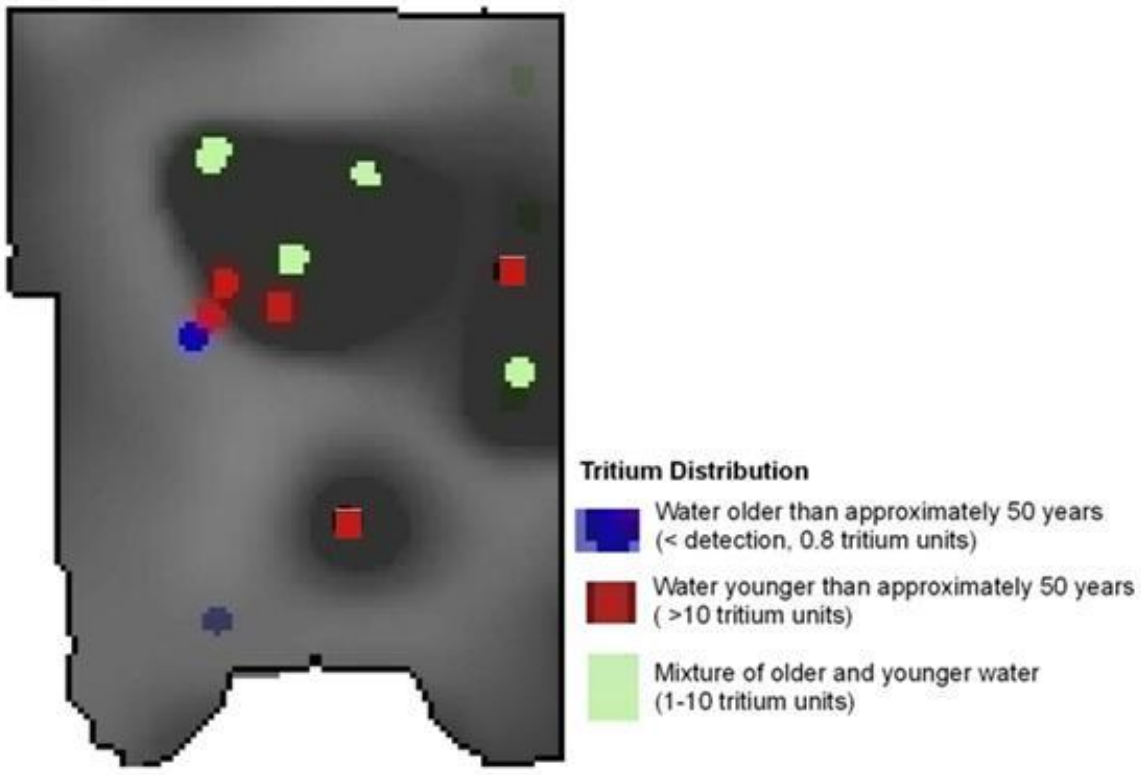


Figure 4-9 Tritium shading contours showing newer water recharging wells.
Darker gray shadowing shows areas where more recent water has recharged the aquifer in the last 50 years.
(Source: Robert Tipping, MGS, Improved Aquifer Characterization in an Urban Area, MN Water Resources Conf., 2008)

4.10 WELLHEAD PROTECTION AREA VULNERABILITY TO STORMWATER INFILTRATION

Infiltration practices redirect stormwater into the subsurface, where it becomes groundwater. As most people in Minnesota use groundwater as a source of drinking water, care should be exercised in planning projects involving stormwater infiltration, especially in vulnerable wellhead protection areas.

Infiltration is widely promoted because it is a practice with demonstrated long-term value in managing stormwater. As a management technique, properly designed and executed infiltration practices convey several benefits, including the following (as identified in the Minnesota Stormwater Manual):

- reducing the volume of stormwater runoff,
- controlling and improving water quality,
- recharging groundwater,
- mitigating thermal affects on cold-water fisheries, and
- attenuating peak flows.

Infiltration is clearly a versatile and effective technique for addressing a wide range of stormwater issues. Accordingly, Minnesota Department of Health (MDH) encourages its use in most settings statewide. See "Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas" in Appendix F.

The MDH categorizes municipal drinking water wells as "susceptible" or "not susceptible" to contamination. Well sensitivity refers to the integrity of the well due to its construction and maintenance. It is based on the results of the well construction assessment. It can be one of the following:

- A well is susceptible to contamination because it does not meet current construction standards or no information about well construction is available.
- A well is not susceptible because it meets well construction standards and does not present a pathway for contamination to readily enter the water supply.

A table showing the sensitivity to pollution of Ramsey County wells is shown in Appendix G. Of all the wells in Ramsey County, only North St. Paul Well #2 is designated by the MDH as "susceptible" to pollution.

However, the bigger picture should be kept in mind. Given the ability of contaminants to migrate down through the "leaky aquitard" of the eroded Decorah Shale that rests on top of the main drinking water aquifer, sensitivity to pollution is still a significant issue. Once contaminants find a path into an aquifer, they will move downgradient toward a point of discharge such as a city well or a river.

Initiatives to address issues related to infiltration of stormwater and potential effect on groundwater are presented in Chapter 5 and it is recommended that the RCD have a role in reviewing stormwater infiltration areas in DWSMAs.

4.11 CLIMATE AND ITS EFFECT ON RECHARGE

Ramsey County is located within a sub-humid climate pattern exhibiting warm, humid summers and cold, dry winters. For the period from 1971-2000, average yearly precipitation amounts for the months of April through October were nearly 21 inches, and an average of approximately 52 inches of snow fell yearly from November to March (Figure 4-10). Rainfall patterns vary significantly over short distances; snowfall patterns tend to be more evenly distributed.

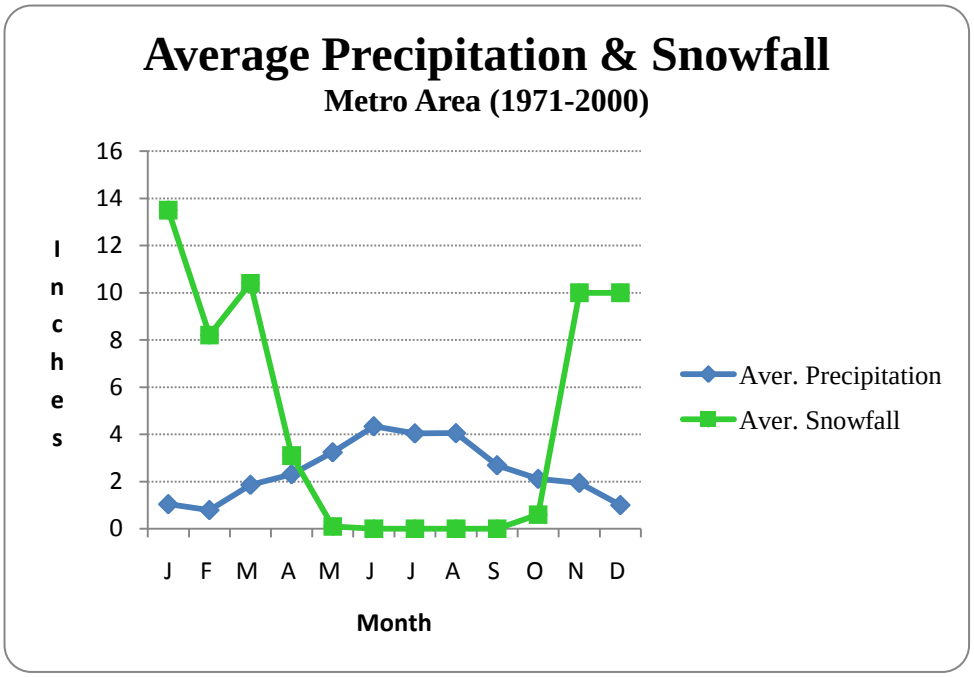


Figure 4-10 Precipitation and snowfall
(Source: Metropolitan Council)

Precipitation either: evaporates from surface water bodies; is returned to the atmosphere through plant and soil transpiration; or recharges groundwater. Rainfall peaks in the summer at the same time when evapotranspiration rates are highest. The cooler fall months are the most conducive to recharge soils and groundwater since evapotranspiration and vegetative water demands decrease. However, precipitation amounts decline during this season, reducing the amount of water available for recharge.

Drought conditions can have significant effects on groundwater recharge. Even droughts of relatively minor duration, such as occurred in the late 1980s, caused concern about reduced water supplies and lower lake levels. These relationships are not well documented in Ramsey County. As mentioned above, initiatives to address issues related to documenting local infiltration of stormwater and potential effect on groundwater are presented in the following chapter.

The DNR's Drought Response Plan, developed by DNR Division of Waters, should be used to provide guidance regarding drought response procedures.

4.12 GROUNDWATER FLOW AND DISCHARGE: WATER TABLE AQUIFER

Groundwater flow in the water table (unconfined) aquifer in Ramsey County is generally from north to south. A map showing the groundwater surface contours and flow direction for aquifers is included below in Figure 4-11 and in the Ramsey County Geologic Atlas. Groundwater from this aquifer discharges into wetlands, springs, lakes, streams, and the Mississippi River. Some groundwater from the water table aquifer leaks into the deeper semi-confined aquifer that many wells in Ramsey County use for municipal and private drinking water.

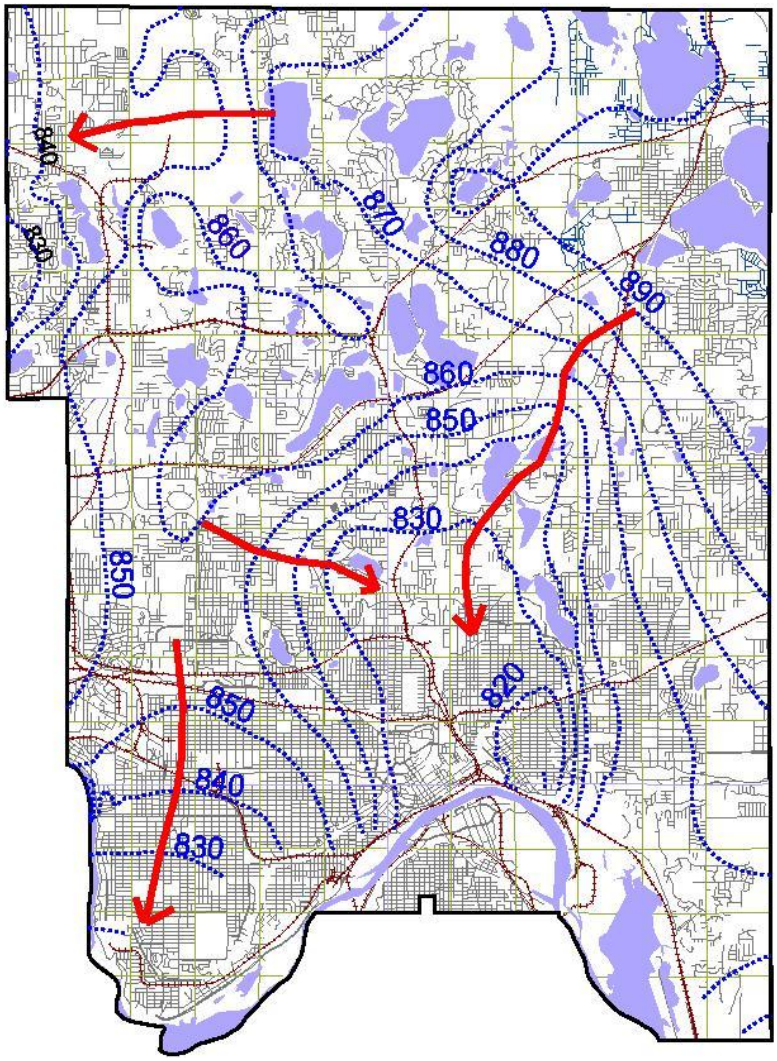


Figure 4-11 Water table aquifer groundwater flow direction
(Source: Minnesota Department of Health)

4.13 GROUNDWATER FLOW AND DISCHARGE: BEDROCK AQUIFER

Groundwater flow in the bedrock (Prairie du Chien-Jordan) aquifers in Ramsey County is generally from the north to the south. Figure 4-12 shows the groundwater surface contours and flow direction for the Jordan aquifer. This aquifer is semi-confined, meaning that it is not completely separated from the water that saturates the overlying glacial deposits and in places; it discharges into the Mississippi River. The Prairie du Chien-Jordan is the most heavily used aquifer in the county. This flow pattern may be locally influenced by groundwater pumping of high-capacity wells.

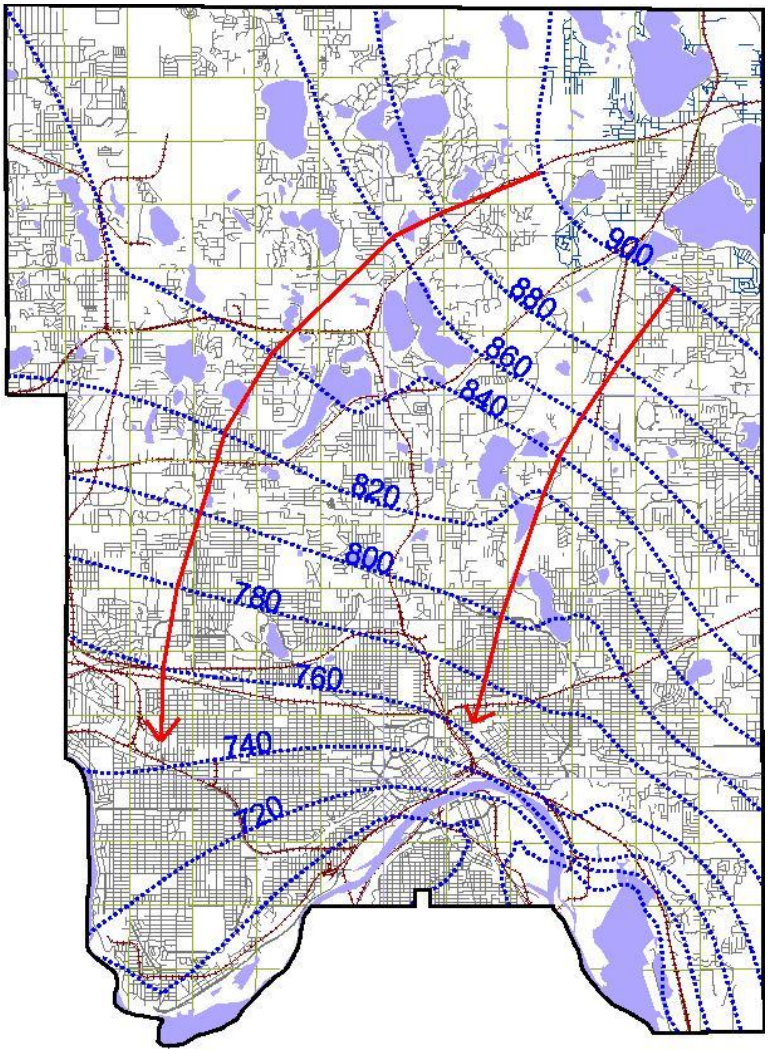


Figure 4-12 Jordan aquifer groundwater flow direction
(Source: Minnesota Department of Health)

4.14 GROUNDWATER DEPENDENT RESOURCES

Groundwater dependent resources are defined as those surface features that are dependent on groundwater to maintain their structure, function, and diversity. The presence of these ecosystems is typically based on a combination of the amount of impervious surface from development, intact natural areas, and the extent of groundwater consumption for water supply. Wetlands and springs, as well as bogs and fens, are the type of surface features that are dependent on groundwater resources.

Some, but not all, of these aquifer/surface connections are shown in Figure 4-13. The areas highlighted are where no confining layer exists between surface water features and underlying bedrock aquifers, and therefore reduction of water levels in those bedrock aquifers could impact surface waters. This interpretation is based on surficial geology, land-surface elevation, bedrock geology, and aquifer water levels. Documentation supporting the aquifer/surface water connections can be found in the Metropolitan Council's 2009 Metro Area Master Water Supply Plan.

For wetlands that have a direct connection with the unconfined aquifer, insufficient groundwater and lower surface elevations and biologic diversity of these water bodies can be affected. This means that flows and water elevations in wetlands and springs could be reduced, leading to the alteration of these ecosystems.

Mapping more precise locations of groundwater dependent resources and determining whether they could be impacted by potential water table elevation declines should be undertaken. A starting point for this proposed mapping program is completion of land cover classification by water management jurisdictions. The Minnesota Land Use Classification System (MLCCS) can be combined with wetland function and value studies and hydrologic studies to assess individual wetlands.

Costs to conduct these types of assessments vary depending on how developed the areas currently are. Generally, the more developed an area is, the less time it might take to conduct these studies. A general cost of $500 – 1,000 per square mile for conducting the MLCCS assessment can be used as an estimate. Additional fieldwork would be required to determine a resource's dependence on groundwater. Individual water management jurisdictions in Ramsey County are at different stages of wetland assessment, so it is not possible to put a precise figure on conducting groundwater resource dependence assessments.

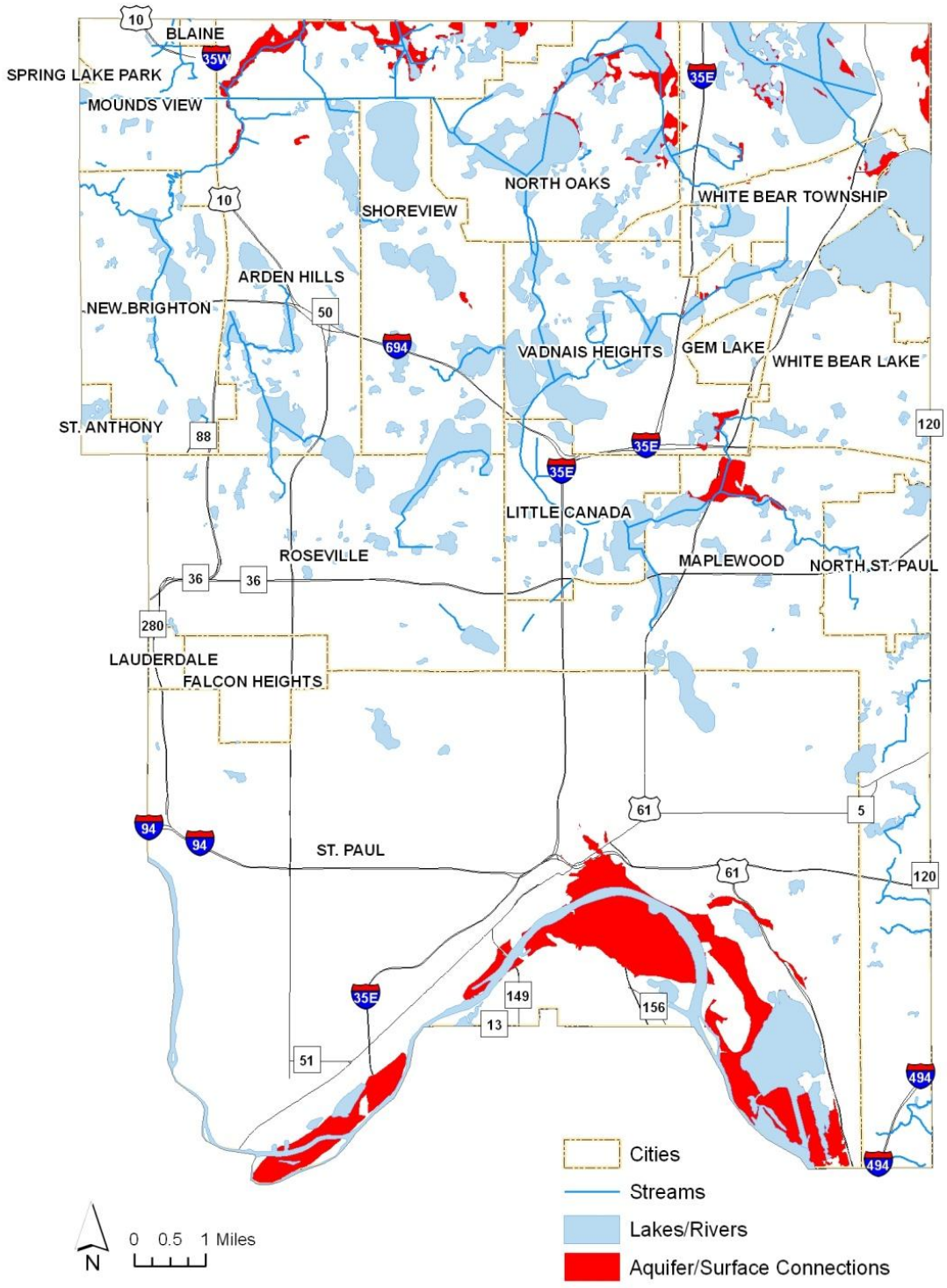


Figure 4-13 Surface water under the influence of groundwater
(Metropolitan Council, 2009 Master Water Supply Plan)

4.15 CAUSES OF GROUNDWATER POLLUTION

4.15.1 Point Sources of Groundwater Pollution

Prior to 1976 when the federal government instituted the Resource Conservation and Recovery Act, chemical wastes and petroleum compounds were essentially unregulated with respect to transport, storage, use, and disposal. As a result, there were many chemical releases at landfills, storage areas, and leaking tanks. These releases frequently resulted in groundwater contamination.

Groundwater contamination moves with groundwater and is dispersed horizontally and vertically over time. This area of contamination, the plume, migrates from the single, point source, toward local and regional discharge areas, like streams and rivers. Municipal and private wells in the plume path are subject to contaminant impact. There are numerous documented sites in Ramsey County with groundwater contamination.

The best known of these contaminant plumes is associated with the Twin Cities Army Ammunition Plant where solvents were placed in an unlined pit and burned. As a result, the cities of New Brighton and St. Anthony were required to install water treatment for their well water. Capital costs for New Brighton's water treatment system was $10.5 million with an additional $1.2 million per year for operations and maintenance. Fortunately, these expenses were paid by the U.S. Army but such funding sources are never guaranteed.

The regulatory environment is more stringent today and this has reduced the likelihood of major new point sources but it has not eliminated it because there is currently no regulatory agency with the mandate to protect groundwater from groundwater contamination, in the first place. The groundwater protection initiatives in Chapter 5 of this Plan will try to fill this gap.

4.15.2 Non-Point Sources of Pollution

Non-point sources of pollution are water pollution from diffuse sources that effects water bodies. Urban runoff and chloride (road salt) are considered non-point sources of surface water contaminants. Runoff is composed of a variety of pollutants including: petroleum residues, heavy metals, sediment, salts and chlorides, nutrients and other hazardous chemicals.

The major contributors to polluted urban runoff are automobiles and roads, automobile service stations, commercial and industrial facilities, salt application and construction sites. Contaminants either infiltrate directly into soils and groundwater from urban runoff or seep into the subsurface from stormwater basins.

4.15.3 Stormwater Impacts on Groundwater

The MPCA's National Pollutant Discharge Elimination System (NPDES) regulations and water management regulations require infiltration of stormwater. Stormwater detention basins slow and trap urban runoff to minimize flooding, improve surface water quality and replenish lakes and streams. Rain gardens are another, less costly and more discrete, way to serve the same purpose.

Recent studies show that rain gardens can be effective at decreasing concentrations of suspended solids (sediment) and nutrients (nitrates or phosphorus) that move from stormwater to groundwater. Specific conductance and chloride concentrations in stormwater infiltration treated through rain gardens are generally lower than background levels. This is an indication that runoff from some sites is diluting groundwater as a result of focused recharge (Tornes, L.H., USGS, Scientific Investigations Report 2005-5189, 2005).

Studies have found that most hydrocarbons are trapped in the first few centimeters of soil in infiltration basins. Depending on the type of hydrocarbon, they may be biodegraded by soil bacteria to a greater of lesser degree (Weiss, LeFevre, and Gulliver, University of Minnesota, 2008). Contaminants that do not sorb (attach) to soil particles may be passed through to groundwater. Results are dependent on local geology and infiltration systems.

Road salt is soluble, non-filterable, and does not readily sorb to solids like soil particles. Therefore they have a high potential for surface water and groundwater contamination. Road salt application on roadways has adverse impacts on groundwater. Other potential contaminants present in road salt include ferric and sodium ferrocyanides (assist in salt handling practices), chromate and phosphate (reduces salt corrosivity).

Road salt pollutes roadside soils, contributes to increased sodium and chloride contents in lakes and streams, and impacts groundwater and wells. Salt and chlorides enter groundwater through application, runoff from uncovered and unlined storage piles, and from snowmelt. Ramsey County, cities, and the Minnesota Department of Transportation all apply salt to the roads they manage during the winter season. Stormwater detention basins have no effect on road salt concentrations as they migrate into groundwater.

Because Drinking Water Supply Management Areas (DWSMAs) represent groundwater within a 10-year travel time of a municipal well, care should be taken with infiltration of stormwater in DWSMAs. This Plan recommends that the MDH's publication, *Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas* (Appendix G), be referenced before deciding on locations of stormwater infiltration systems in DWSMAs. RCD has assisted the City of Shoreview with design options for less expensive stormwater treatment and infiltration facilities and one of the Plan's initiatives focuses on having RCD having a role in reviewing stormwater infiltration in DWSMAs.

4.16 CURRENT GROUNDWATER MONITORING IN RAMSEY COUNTY

The water level in sixteen (16) DNR observation wells (Figure 4-14 and Appendix E) is measured once a month (10 times a year) by the Ramsey Conservation District. The data are then provided to the DNR, USGS, and the Metropolitan Council for use in tracking long-term trends in groundwater availability. These agencies have stated that monthly data are only useful for determining the general state of groundwater levels. In order to quantify groundwater recharge from rainfall or for use as input into groundwater computer flow models, far more frequent data are necessary. A program to collect additional groundwater elevation data is recommended in this Plan (Chapter 5). The existing DNR observation network in Ramsey County consists of the following wells in Table 5:

Table 5 - DNR observation well details

DNR Observation Wells
Ramsey County

	Well Nest?	DNR ID No.	MDH ID No.	Depth	Grnd. Elev. (ft)	Unconsolidated or Bedrock?	Aquifer
1		62001	200874	523	997.01	Bedrock	Jordan
2		62002	200105	325	946.64	Bedrock	St. Peter
3		62008	244345	163	900	Unconsolidated	Quat. Buried Artesian Aquifer.
4		62009	200443	523	967.86	Bedrock	Prairie Du Chien-Jordan
5	Nest	62010	244346	80	970.81	Unconsolidated	Till
6		62048	623058	49	970.71	Unconsolidated	Quat. Water Table Aquifer.
7		62033	244359	96	928.7	Unconsolidated	Quat. Buried Artesian Aquifer.
8	Nest	62038	481807	226	928.36	Bedrock	Prairie Du Chien-Jordan
9		62039	227977	46	929.18	Unconsolidated	Quat. Water Table Aquifer.
10		62030	206833	536	964.94	Bedrock	Jordan
11		62034	244360	234	888	Bedrock	St. Peter
12		62037	225652	403	884.43	Bedrock	Prairie Du Chien-Jordan
13		62040	200054	558	1045.41	Bedrock	Jordan
14		62044	551564	195.5	930.15	Bedrock	Prairie Du Chien
15	Nest	62045	551575	31	930.04	Unconsolidated	Quat. Buried Artesian Aquifer.
16		62046	225647	-	926.23	Bedrock	Mt. Simon

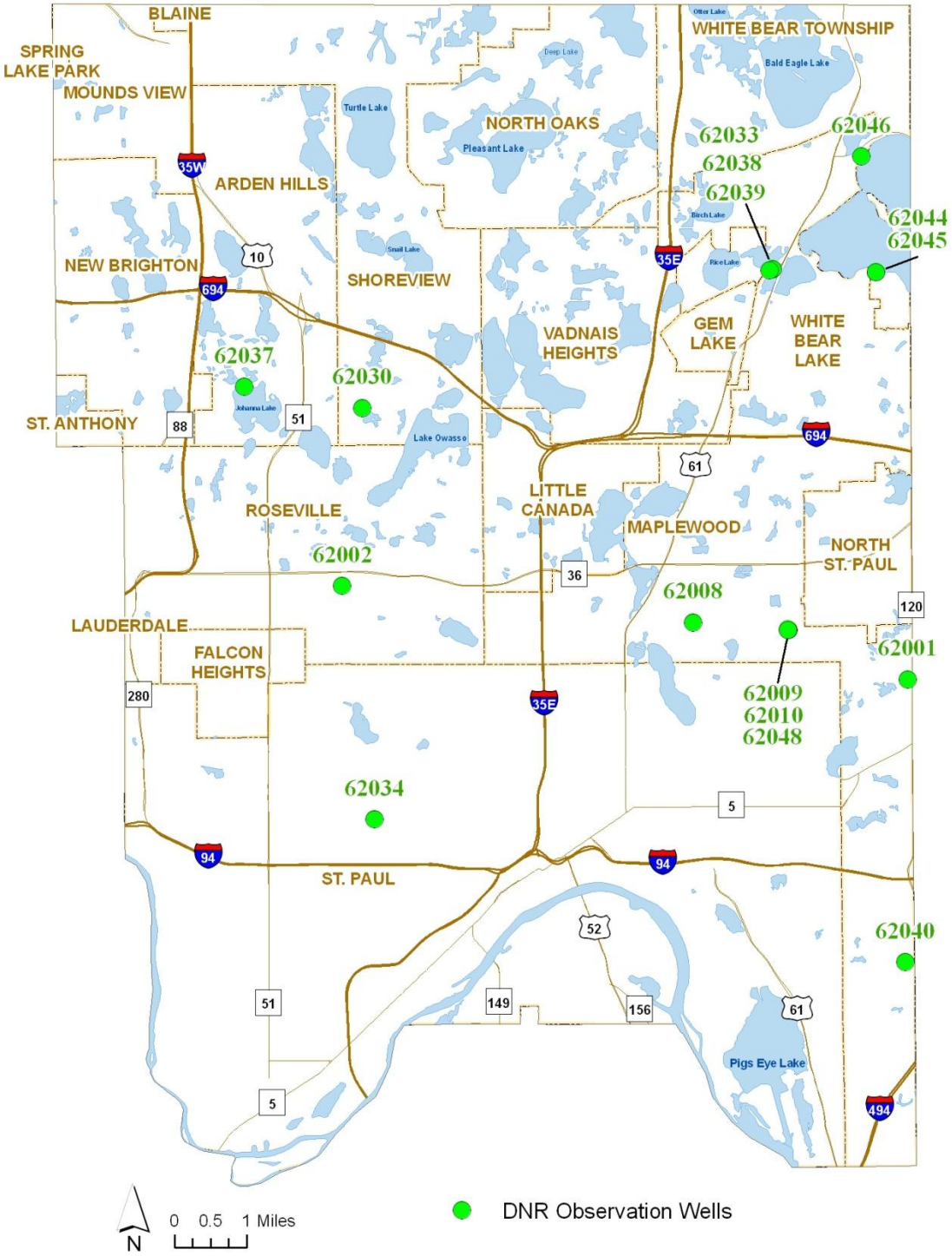


Figure 4-14 DNR water level observation wells monitored by RCD

Beside the 16 observation wells monitored by the RCD, the DNR reads an additional three "vibe" wire wells at the University of Minnesota campus and may read a well at the MPCA building on Lafayette Road in St. Paul. In addition, the DNR has identified three areas in Ramsey County where three additional wells are needed. Each DNR well is expected to include, at a minimum, a water table well, a Prairie du Chien/Jordan well, and a Mt. Simon well. They are as follows:

- A well nest in northwest corner of Ramsey County,
- A well nest in north central the County (near Shoreview) to track the groundwater impacts of the St. Paul Regional Water Services pumping, and
- A well nest in the south-southeast corner of the County.

4.17 MUNICIPAL WATER SUPPLY ADEQUACY

The Metropolitan Council's 2009 Metropolitan Area Master Water Supply Plan states that while groundwater supplies are adequate for the present, by 2030, projected demand may result in localized aquifer drawdown around pumping centers and that this drawdown may, in turn, cause unwanted localized effects such as contaminant migration, well interference, and lowering of surface water levels in some areas within the county. Localized drawdown is expected to occur particularly near high growth centers, such as in neighboring Washington County. This designation was for the parts of Ramsey County not served by the St. Paul Regional Water Service.

4.18 WATER SUPPLY INTERCONNECTION

Municipal water supply systems benefit from the ability for sharing between cities in case of an emergency. This interconnection requires that water supply systems be connected so that if water is disrupted in one community, it can be supplied by another. Of all the cities in Ramsey County shown below in Figure 4-15, only North St. Paul, St. Paul, and Vadnais Heights lack water supply interconnections. It should be noted that the St. Paul Regional Water Services (and by extension, its customers) has taken steps to provide for emergency water supplies by installing its own backup groundwater supply wells. This effectively provides for the temporary replacement of their entire surface water supply in emergencies. The city of Vadnais Heights reports that it is not interconnected because they do not treat their groundwater and their neighbors do. Gem Lake and that portion of North Oaks not served by White Bear Township are exceptions because most of their residents are served by private wells.

Water supply interconnection, both inter-municipal and inter-county, should be a goal in Ramsey County.

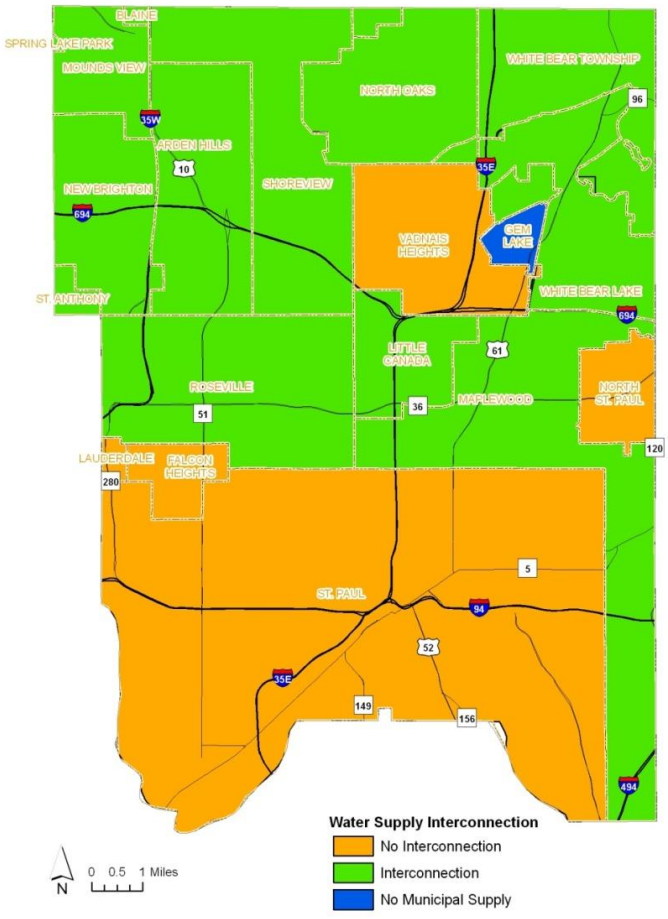


Figure 4-15 Water Supply Interconnection (Ramsey Co.)
(Metropolitan Council, 2007, Water Supply, Legislative Report)

4.19 POPULATION, LAND USE AND DEVELOPMENT

Ramsey County, home of the state capital of St. Paul, is located in east central Minnesota and is the smallest county in the state with an area of 170 square miles. The county is bordered by Anoka, Dakota, Hennepin and Washington Counties and was officially established in 1849. Nearly one-half million residents reside within the 18 cities (3 of which are shared with adjoining counties) and one township which compose the county's local jurisdictions (Figure 4-16). A seven member County Board of Commissioners, county departments, municipal governments, and nine watershed organizations (Figure 4-17) all provide a variety of services for the public.

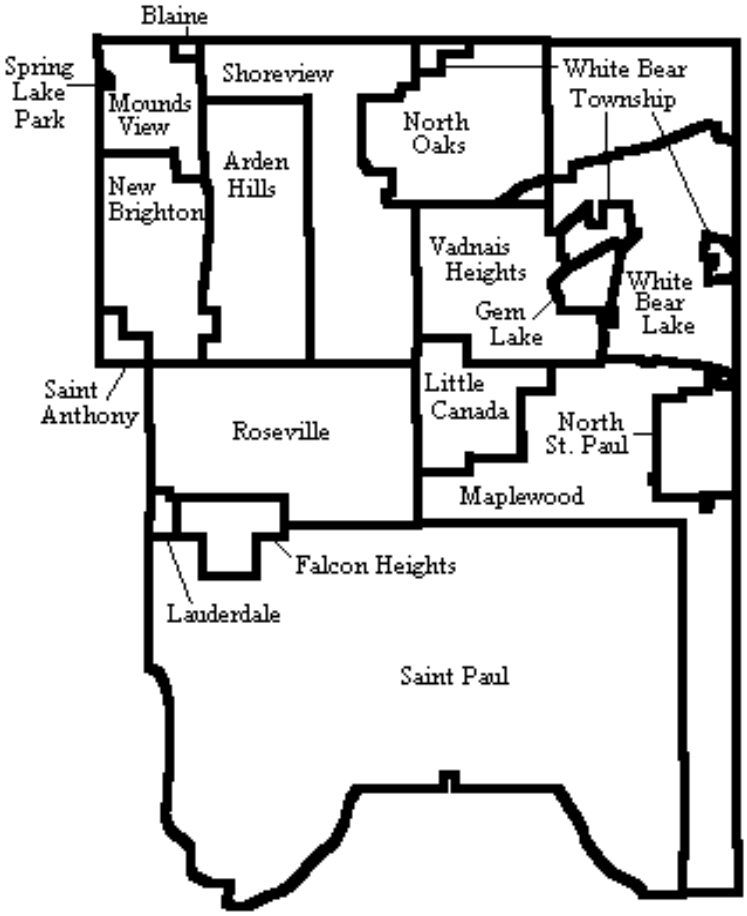


Figure 4-16 Local city boundaries

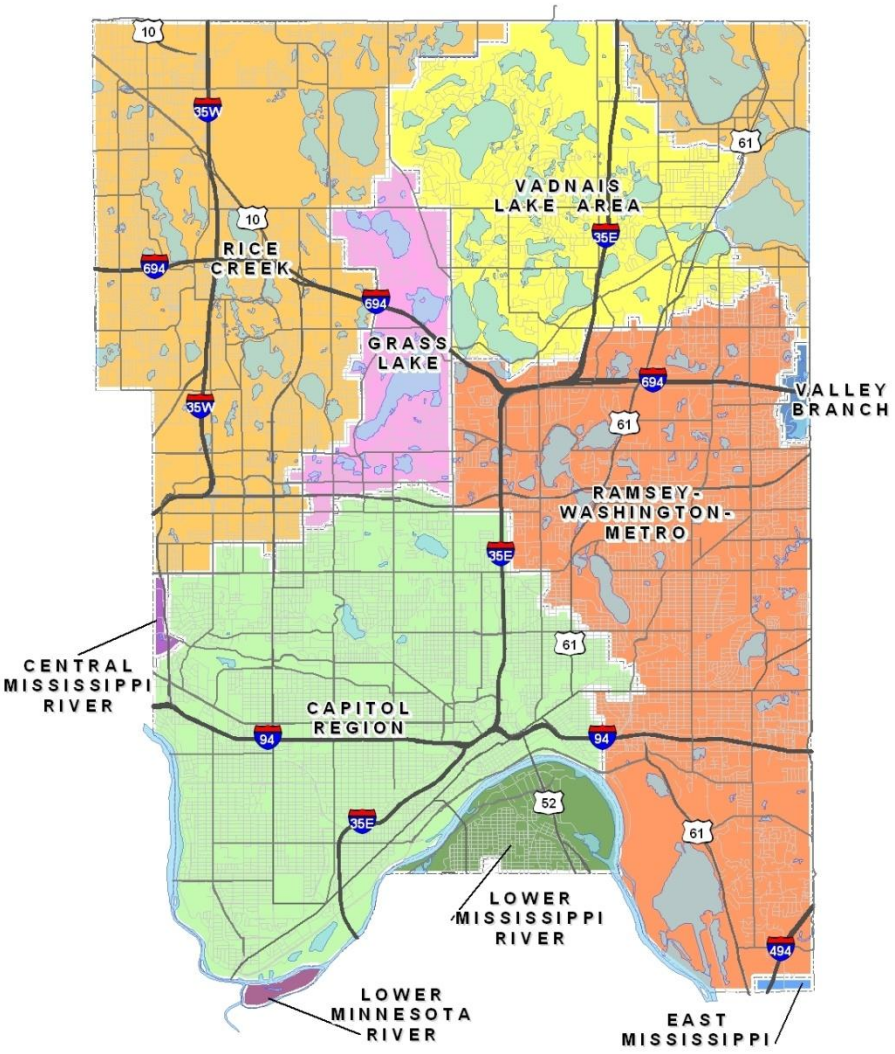


Figure 4-17 Watershed organizations

Ramsey County is one of the original nine counties within Minnesota. Its location near the confluence of the Minnesota and Mississippi Rivers made it an ideal site for a major trade center which led to the rapid development of communities in the southern portion of the county. In the last few decades, increasing population and land development have resulted in the almost complete urbanization of Ramsey County. As a result, future overall land use patterns will not be significantly altered. However, rezoning and redevelopment within communities may locally affect land use patterns and have the potential to impact the quality of groundwater resources.

Land use within Ramsey County is classified into several categories with residential development consuming the greatest amount of land area (Figure 4-18).

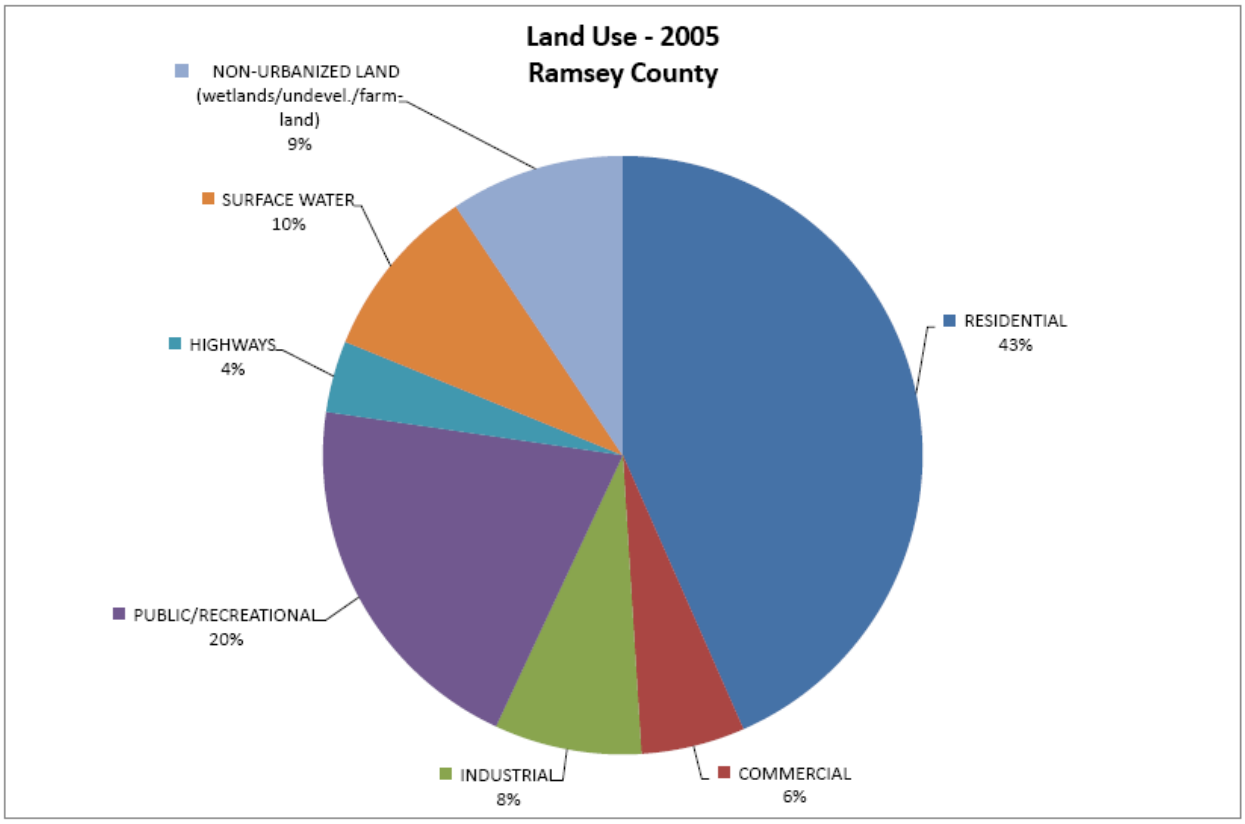


Figure 4-18 Ramsey County land use
(Source: Metropolitan Council)

In general, most cities in Ramsey County are fully developed so that future overall land use patterns will not be significantly altered. However, rezoning and redevelopment within communities may locally affect land use patterns and have the potential to impact the quality of groundwater resources. There remain approximately 10,000 acres of "non-urbanized land", consisting of wetlands and undeveloped property, that serve as natural groundwater and surface water protection.

All forms of development alter the physical environment of Ramsey County. Development practices (e.g. excavating soil and geologic materials, constructing impervious surfaces, filling for roadways and homes, and building drainage systems) are significant factors affecting geologic, soil, and water flow processes. Local governments should take into consideration the impacts of land use and development upon the natural environment. Performing land use planning decisions with an inclination towards water resource quality and supply assists in the protection of groundwater resources.

Land use has intensified in the last 12 years since the original Groundwater Protection Plan was issued in 1996. Metropolitan Council data from 1970 to 2005 shows that the number of acres of "non-urbanized land", consisting of wetlands, farmland, and undeveloped land, has shrunk

significantly (Figure 4-19) while the percent of developed acreage has risen to approximately 90% (red dashed line below).

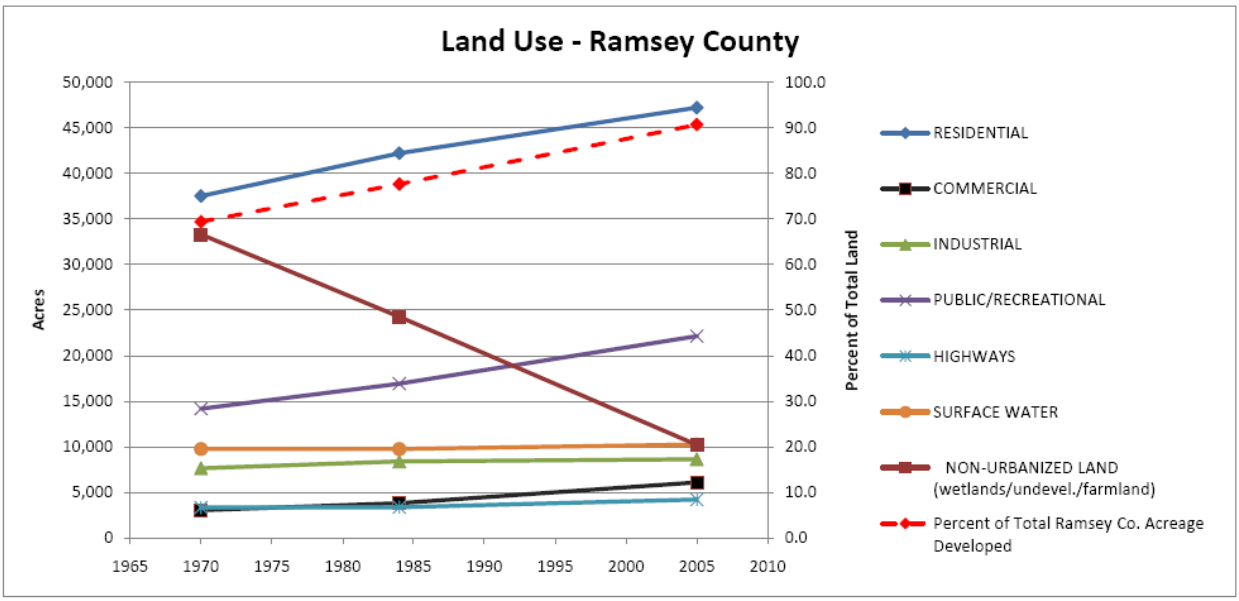


Figure 4-19 Ramsey County land use changes, 1970 – 2005
Acreage for each land use is plotted against the left side of the graph. Percent of total Ramsey Co. acreage developed is plotted on the right side of the graph. (Data source: Metropolitan Council)

Land use changes in Ramsey County have resulted in a reduction of permeable land surface which has in turn likely reduced stormwater infiltration. The table in Appendix C, Land Use, shows these land use changes for each of the cities in Ramsey County.

One of the initiatives in Chapter 5 emphasizes the need to use open space as a groundwater (and surface water) management tool that can promote water quality as well as improved habitat and public enjoyment.

5.0 Groundwater Protection Initiatives

5.1 DETAILS OF INITIATIVES

Tangible, effective groundwater protection will be achieved by putting in place several programs and initiatives that, in the aggregate, will make a difference in protecting the resource. No one approach will be a "silver bullet" solution and it will require institutionalized effort to manage the process. Most of the proposed initiatives are not currently in effect but they represent ways to document the status of the groundwater resource and/or effectively protect it from adverse effects of past, current, and future land uses.

Watershed districts, water management organizations, cities, water providers, Ramsey County, and Ramsey Conservation District will each have different roles and responsibilities described in this Plan. The following table lists the initiatives recommended by our Technical Advisory Committee and reviewing agencies.

Organization	Initiatives responsible for:
Ramsey Conservation District	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Ramsey County Groundwater Partners	11
Water management jurisdictions	12, 13, 14
Cities' planning departments and water providers	15
St. Paul-Ramsey County-Public Health	16

Table 6 - Groundwater Protection Initiatives

INITIATIVE	LEADER	PARTNERS
1. RCD and the proposed Ramsey Co. Groundwater Partnership to assume leadership role in countywide groundwater protection and RCD to manage groundwater database.	Ramsey Conservation District	Watershed districts/WMOs/water providers/ Ramsey County Groundwater Partnership
2. Annual ambient groundwater quality data acquisition program - city wells and selected observation wells.	Ramsey Conservation District	Watershed districts/WMOs/Ramsey County Groundwater Partnership
3. Continuous automated groundwater elevation data collection program.	Ramsey Conservation District	Watershed districts/WMOs/Ramsey County Groundwater Partnership
4. Fund sealing of unused residential wells cost-share program. Participation and qualification details are left to the discretion of the funding partners.	Ramsey Conservation District	Watershed districts/WMOs/water providers
5. Education and outreach to LGUs and public on topics related to Ramsey County groundwater (i.e., consumption, lawn watering).	Ramsey Conservation District	Watershed districts/WMOs/water providers
6. RCD and the Ramsey County Groundwater Partnership will assist water providers with land use management issues and developing land use rules in DWSMAs as well as assisting non-municipal community water suppliers with their Wellhead Protection Plans.	Ramsey Conservation District	Cities/water providers/ Ramsey County GIS User Group
7. Provide expertise on surface water – groundwater interaction to water jurisdictions and LGUs in order to protect groundwater. Engage in long-term monitoring.	Ramsey Conservation District	Watershed districts/WMOs/cities

INITIATIVE	LEADER	PARTNERS
8. SPECIAL PROJECT: RCD will coordinate an evaluation of two possible sources of groundwater contamination: hazardous waste generators and County unpermitted dump sites. Solutions will take a risk-based approach.	Ramsey Conservation District	St. Paul-Ramsey County-Public Health/MPCA/ Minnesota Dept. of Health/cities
9. SPECIAL PROJECT: RCD will undertake a review of MPCA files related to approximately 80 unpermitted dumps to look for indications of groundwater impacts.	Ramsey Conservation District	St. Paul-Ramsey County-Public Health /MPCA/ Minnesota Dept. of Health/cities
10. SPECIAL PROJECT: Assemble GIS database of stormwater infiltration structures that could pose threats to groundwater in emergency response spill situations and infiltration from non-point sources.	Ramsey Conservation District	Watershed districts/WMOs/ cities/ Ramsey County-Emergency Management & Homeland Security
11. Encourage Met Council and MPCA to proceed with contaminated soil and groundwater plume mapping project for the for the 11-county Metro area. Partners will provide relevant groundwater information. RCD will provide information from file review of MPCAs Unpermitted Dumps and County dump site list.	Metropolitan Council/Ramsey County Groundwater Partnership	Not applicable
12. Emphasize stormwater reuse where possible by water organizations to help cities meet non-degradation standards.	Watershed districts/WMOs/ cities' permitting agencies	Ramsey Conservation District
13. Permitting process should be used to direct stormwater infiltration away from contaminated soils or known areas of groundwater contamination.	Watershed districts/WMOs and cities' permitting agencies.	Ramsey Conservation District

INITIATIVE	LEADER	PARTNERS
14. Water management organizations should identify and map groundwater dependent natural resources in order to protect them from degradation.	Watershed districts/WMOs	Ramsey County Groundwater Partnership
15. Support open space and land use easements in hydrologically sensitive areas as passive mechanisms that protect groundwater.	Cities' planning departments and water providers	Ramsey Conservation District/Ramsey County Groundwater Partnership/Ramsey County
16. County adoption of State of Minnesota code for Individual Sewage Treatment Systems in order to assure adequate dispersal and treatment of domestic sewage before it infiltrates to groundwater.	St. Paul-Ramsey County-Public Health	Ramsey Conservation District and municipalities

Descriptions and details of each of these programs, with associate costs to complete the tasks, follow below:

GROUNDWATER PROTECTION INITIATIVES

1. RCD and the proposed Ramsey County Groundwater Partnership to assume a leadership role in countywide groundwater protection.

Countywide groundwater protection requires a structure for organizing and implementing programs. A countywide organization with the necessary resources and focus on groundwater protection is needed to fill this role. This organization could be called the Ramsey County Groundwater Partnership (RCGP).

Responsibilities of the RCGP would include:

- Implementation and oversight of initiatives in the Ramsey County Groundwater Protection Plan.
- Coordination of groundwater data collection by groundwater partners.
- Central repository of groundwater data collected by RCD and groundwater partners.
- Pursue grant funding opportunities for projects across Ramsey County.
- Publication of an Annual Groundwater Report to the residents of Ramsey County.
- Institutionalization of countywide groundwater protection.
- Semiannual meetings of the proposed Ramsey County Groundwater Partnership to review the work program and assess progress.
- Share data between partners on groundwater issues (i.e., groundwater infiltration BMPs in critical city Drinking Water Supply Management Areas).
- Provide a forum for mutual drinking water protection issues related to overlapping municipal Drinking Water Supply Management Areas (DWSMAs) or DWSMAs extending into other cities. However, this would not supplant any state or federal role in these matters.
- Engage adjacent counties on shared groundwater issues.
- Education and outreach on issues pertaining to groundwater and its' protection.
- Partner meetings should be scheduled two to three times per year.

Because groundwater moves across watershed and political boundaries, no one partner can effectively protect even its own groundwater. Ramsey Conservation District, as the author of the Groundwater Protection Plan and holding countywide responsibilities, is the natural choice to fill this organizational role and implement programs. Individual partners would be free to pursue their own groundwater protection and monitoring programs at their discretion and then provide the data to RCD for dissemination.

RECOMMENDATIONS

- Implementation of countywide programs would require funding from partners and financial accountability by the Partnership. Of the following organizational structures: Joint Powers Organization, Memorandum of Understanding (MoU), or work group, the most flexible and most accountable structure would be a MoU. No additional layer of

regulation will result from this Partnership. The MoU would not have regulatory authority. Partners in the MoU would enforce regulations within their own jurisdictions.

- Partners could implement their own groundwater protection initiatives within their boundaries while also benefiting from a countywide organization and countywide program implementation. Partners could also rely on RCD for additional services on a case-by-case basis.

Implementation should be guided by the Ramsey County Groundwater Partnership that should include:

All cities in Ramsey County	St. Paul-Ramsey County-Public Health
Capitol Region Watershed District	Ramsey County-Environment
Grass Lake Water Management Organization	Ramsey Conservation District
Lower Mississippi River Water Management Organization	Department of Natural Resources
Ramsey Washington Metro Watershed District	Minnesota Pollution Control Agency
Rice Creek Watershed District	Minnesota Department of Health
Vadnais Lake Area Water Management Organization	Metropolitan Council
St. Paul Regional Water Services	

Cost: RCD responsibility as part of staff resource time.
Funding Sources: To be determined as per Section 5.4
Benefit: Consistent countywide leadership focused on groundwater protection. Currently, no agency has this mission.
Leadership: Ramsey Conservation District
Partners: Proposed Ramsey County Groundwater Partnership members (see above).
Timeline: Start 2010
Reporting: Annual Groundwater Report will include data stipulated by the Groundwater Partnership.

GROUNDWATER PROTECTION INITIATIVES (continued)

2. Annual ambient groundwater quality data acquisition program - selected observation wells.

The general status of groundwater quality in Ramsey County is not currently being monitored adequately. A baseline and trend monitoring program should be conducted in Ramsey County to understand groundwater chemistry in the shallow aquifer. Preserving the long-term quality of the county's groundwater resources requires that policy makers have access to accurate information based on sound scientific principles.

The MPCA monitors a small number of wells in Ramsey County. One well in the unconfined aquifer and several selected wells in North Oaks Thus, the only wells sampled to determine ambient groundwater quality (not associated with a contamination site) are located in the north-central part of the county and are monitored by the MPCA program.

Groundwater quality samples from the 58 municipal wells are collected by the MDH. However, only 24 are sampled individually and before treatment. Water quality on the remaining 34 wells is not known due to the influence of mixing water from multiple wells or due to sampling of treated water. The MDH is considering changing its sampling practices to collect well water from pre-treatment sources.

RECOMMENDATIONS:

- If practical, the MDH should sample the remaining 34 water wells on a pre-treatment basis. In addition, ten (10) wells should be identified and sampled by RCD to provide ambient groundwater data during the first year of implementation. Ten wells do not represent an "optimal" number of monitoring points in an ambient monitoring program. It simply represents an attempt to document ambient groundwater conditions; not define groundwater contamination. This sequential approach will allow the program to grow and adjust over time. These wells should be selected from existing wells completed in the shallow, unconfined aquifer whose condition may be a harbinger for future conditions in the deeper aquifers. The number should double to 20 wells in the second year. Later sampling events could focus on the deeper, semi-confined aquifers.

- Due to individual circumstances, some water management organizations may have a need to collect additional groundwater data, beyond that collected as a part of this Plan. For example, the need to collect additional data could be related to an investigation of groundwater/surface water interaction at a particular water body.

- A sampling and analysis plan will be developed and implemented that would provide for the collection of samples annually by the RCD or groundwater partners' staff.

- Analyses would be: Volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), perfluorochemicals (PFCs), RCRA metals, chloride/bromide, nitrate-nitrite, phosphorus, alkalinity, pH, temperature, conductivity, and dissolved

oxygen, Any additional data from groundwater monitoring by our groundwater partners, above and beyond RCD's, will be gathered by RCD for storage and reporting.

- Sampling results will be reported in a RCD Annual Groundwater Report. All data would be collected and made available through a website maintained by RCD as well as shared with the MPCAs Ambient Groundwater Program through their STORET program, as well as with other interested agencies.

Cost:	RCD sample collection and project management: 1st year: $12,750 2nd year: $12,750 Laboratory analysis-1st year: $13,000 Laboratory analysis-2nd year: $26,000
Funding Sources:	To be determined as per Section 5.4
Benefit:	Ongoing documentation of existing countywide ambient groundwater quality. No current program exists.
Leadership:	Ramsey Conservation District
Partners:	Watershed districts/WMOs/Ramsey County Groundwater Partnership
Timeline:	Start 2010
Reporting:	Annual Ramsey County Groundwater Report will include update information.

GROUNDWATER PROTECTION INITIATIVES (continued)

3. Implement an automated, continuous groundwater elevation data collection program.

Ramsey Conservation District currently measures water level elevations in 16 DNR observation wells on a monthly basis. This frequency of data collection is poorly matched with the needs of the regional, state, and federal agencies that use the data to make projections of groundwater recharge in Ramsey County. Monthly data readings are good for historical reference but are of little use in modeling groundwater recharge; the real need. Given the current lack of usable data, agencies are often relying on assumptions and trends cannot be found.

This augmentation of the monitoring network is necessary to develop a dataset that can be used to distinguish impacts of groundwater withdrawal on groundwater dependent natural resources from natural variability due to changes in annual precipitation.

RECOMMENDATIONS:

- A program is proposed that would install water level monitoring devices called "pressure transducers" in 14 of the 16 DNR observation wells in Ramsey County. Two of the 16 wells are active and would not provide accurate information on static water levels. These devices are hung in water wells and automatically collect water level data as frequently as desired; daily, hourly, or faster. Some wells will require minor modification by a licensed well driller to allow access. Pressure transducers cost approximately $400 each and can be easily hung in wells. At least one or two barometric pressure sensors would need to be deployed. Groundwater elevations can be compared to rain gauge amounts and provide much more valuable information about groundwater recharge than is currently available.

- In addition to the downloadable pressure transducers, an opportunity exists to partner with the MPCA to install a fully uplinked groundwater elevation monitoring system that would continuously feed data to the USGS database to provide real-time data, stored in the USGS's computer servers, and make Ramsey County a part of the data used to model groundwater elevations in the Metro area. This possibility can be explored at a future date.

- The proposed Ramsey County Groundwater Partnership will work with the DNR to determine whether the existing observation network adequately monitors conditions as they change due to water supply withdrawals. The proposed program would further the critical understanding of groundwater recharge in Ramsey County.

- Due to individual circumstances, some water management organizations may have a need to collect additional groundwater data, beyond that collected as a part of this Plan. For example, the need to collect additional data could be related to an investigation of groundwater/surface water interaction at a particular water body.

- A plan will be developed and implemented that would provide for groundwater elevation monitoring by the RCD or groundwater partners' staff.

Cost:	RCD data collection and project management: 1st year: $12,750 2nd year: $12,750 Capital cost: 1st year: $9,500 2nd year: $9,500
Funding Sources:	To be determined as per Section 5.4
Benefit:	Documentation of rapidly changing groundwater elevation conditions and collection of data to calibrate cities' groundwater models and track groundwater recharge.
Leadership:	Ramsey Conservation District
Partners:	DNR/Watershed districts/WMOs/Ramsey County Groundwater Partnership
Timeline:	Start 2010
Reporting:	RCD Annual Groundwater Report will include update information.

GROUNDWATER PROTECTION INITIATIVES (continued)

4. Fund a program for sealing unused water wells.

A program is recommended to increase the number of wells sealed annually in Ramsey County. Unused (abandoned) wells create a pathway for contaminants to move vertically in an aquifer. Unused submersible pumps also pose a threat due to the presence of PCBs in electrical capacitors in some of the pumps. These wells, when no longer in use, can allow contaminant plumes to spread faster than the aquifer itself.

Sealing of unused water wells in Ramsey County is currently funded partially by a handful of watershed organizations and/or cities. RCD also has a $10,000 federal matching grant that would pay 50 percent of the cost to seal 18 wells. Of the estimated 27,000 unused wells in Ramsey County, approximately 300 water wells are sealed annually in the County (not including environmental monitoring wells). Most of the well sealing work is currently done in response to property transactions. At this rate, it would take 90 years to seal the existing wells.

RCD proposes to offer residents of areas in Ramsey County that do not have access to other such programs through the City of Saint Paul or Capital Region Watershed District, the opportunity to have part of the well sealing costs shared by RCDs' funding partners. If it was determined that specific areas were high priorities, i.e., inside DWSMAs, these areas could be targeted for a program to identify wells for possible sealing. Typical well sealing costs are less than $1,000. RCD recommends a 50% match, an income limit, and would not cover sealing for a pending property transaction.

RECOMMENDATIONS

- An existing $10,000 federal grant covered the matching costs for sealing 18 wells. If adopted, this new program would need additional funding. If 50 wells per year were sealed, the required matching funds would be approximately $25,000. Some administrative costs would also be incurred.

- Participation and qualification details are left to the discretion of the funding partners.

Cost:	Average cost to seal a well in Ramsey County: $1,020 Average cost-share amount: $500 Anticipated administration cost per well sealed: $75
Funding Sources:	To be determined as per Section 5.4
Benefit:	Faster elimination of potential contaminant pathways will provide groundwater protection to municipal wells.
Leadership:	Ramsey Conservation District
Partners:	Watershed districts/WMOs and water providers
Timeline:	Start 2010
Reporting:	RCD Annual Groundwater Report will include update information.

GROUNDWATER PROTECTION INITIATIVES (continued)

5. Education and outreach to cities and public on topics related to Ramsey County groundwater (i.e., water consumption, lawn watering, well sealing, etc.).

Ramsey Conservation District will create opportunities to inform the public regarding groundwater protection and conservation:

RECOMMENDATIONS

- RCD will establish and maintain a groundwater section of the existing RCD website,
- maintain advisory relationships with local units of government and continue role of interpreting groundwater related issues,
- participate in public awareness activities in support of groundwater quality efforts,
- participate in the Children's Water Festival, Minnesota State Fair Grounds and the Senior Envirothon for high school students, and
- examine municipal Water Supply Plans to share information between communities.

Cost:	No specific programs have yet been designed or proposed. No costs are currently known.
Funding Sources:	To be determined as per Section 5.4
Benefit:	Increased public awareness of the benefits of groundwater protection and the part all of us can play.
Leadership:	Ramsey Conservation District
Partners:	Watershed districts/WMOs and water providers
Timeline:	Start 2010
Reporting:	RCD Annual Groundwater Report will include details of education and outreach programs.

GROUNDWATER PROTECTION INITIATIVES (continued)

6. Assist water providers with development of land use management practices to protect Drinking Water Management Areas (DWSMAs) as well as assist non-municipal community water suppliers with their Wellhead Protection Plans.

Municipal Wellhead Protection Plans require the delineation of Drinking Water Supply Management Areas (DWSMAs) around their water supply wells, identification of potential sources of contamination, and implementation of groundwater protection goals and objectives. A DWSMA is a geographical boundary showing a 10-year travel time for groundwater to a nearby municipal well. Wellhead Protection Plans are an acknowledgment of the physical connection between surface land use and groundwater.

Community water suppliers are already confronted with stormwater infiltration and land use issues within their DWSMAs. RCD has been a source of answers for these critical questions. RCD helped one water provider with a critical stormwater infiltration issue within the DWSMAs Emergency Response Action boundary (one-year groundwater travel time). RCD staff consulted MDH staff and a solution, involving a limited groundwater study, was formulated that worked for the city.

Unless considered in land use decisions, the tendency is to forget about the sensitive nature of our groundwater resource. Many land use decisions should be informed by this information and awareness.

Some cities have yet to begin their Wellhead Protection Plans, so implementation in the yet to be determined DWSMAs can be done on an as-needed basis. In addition, most non-municipal community water suppliers (such as mobile home parks) have not completed their Wellhead Protection Plans and RCD could assist with their completion, provided that grant program funding can be found.

RECOMMENDATIONS

- DWSMAs should be displayed as a layer on the Ramsey County GIS User Group's website so that these vulnerable areas can be considered in planning and zoning decisions.

- At the request of respective cities' staff, RCD can assist with review of stormwater infiltration issues in DWSMAs and groundwater recharge areas, as well as other pertinent land use issues that are identified in Wellhead Protection Plans, approved under Minnesota Rules 4720.

- RCD is open to the option of assisting non-municipal community water suppliers, such as mobile home parks, that have not completed their Wellhead Protection Plans, providing that grant program funding can be found.

- Ramsey County supports inter-governmental cooperation and coordination in support of an effort to develop land use management practices that would protect groundwater. This would be a point of discussion by the proposed Ramsey County Groundwater Partnership. Land use strategies would be based on completed studies and rankings of groundwater recharge areas.

Cost:	Maps: Existing resources/no cost Other: Unknown costs
Funding Sources:	Water providers and/or State grants
Benefit:	Public awareness of the geographic boundaries of the DWSMAs on city planning maps will provide the first level of protection for groundwater aquifers and the cities' significant investments in water supply wells.
Leadership:	Ramsey Conservation District
Partners:	Cities/water providers/ Ramsey County GIS User Group
Timeline:	Start 2010
Reporting:	Confirm in RCD Annual Report.

GROUNDWATER PROTECTION INITIATIVES (continued)

7. Provide expertise on surface water – groundwater interaction to water management jurisdictions and LGUs in order to protect groundwater.

Surface water and groundwater are inextricably linked. Many surface water features such as wetlands and springs are dependent on the unconfined groundwater aquifer to maintain flow or water levels. Groundwater aquifers are vulnerable to contamination for stormwater runoff. This is a critical concern within Drinking Water Supply Management Areas (DWSMAs).

Many cities and local water management organizations are not staffed to specialize in groundwater related issues. RCD is actively participating in a long-term study of surface water-groundwater interaction at a large porous pavement stormwater infiltration area in Shoreview. Funding is being provided by the Grass Lake Water Management Organization.

RECOMMENDATIONS

Potential areas where RCD could assist LGUs are as follows:

- Serve as advisory and review resource for cities and local governmental units for groundwater issues (i.e., groundwater infiltration in critical city Drinking Water Supply Management Areas)
- Determine influence of unconfined aquifer water level on surface water features.
- Assess effect of potential drought conditions on surface water bodies.
- Provide scope-of-work studies to identify groundwater recharge areas.

Cost:	Mitigation practices, best management practices, and monitoring costs are highly variable and unpredictable.
Funding sources:	To be determined as per Section 5.4
Benefit:	Water organizations could draw on RCD groundwater staff time and expertise on issues related to surface water-groundwater interaction.
Leadership:	Ramsey Conservation District
Partners:	Watershed districts/WMOs and cities
Timeline:	Start 2010
Reporting:	Include updates in RCD Annual Report.

GROUNDWATER PROTECTION INITIATIVES (continued)

8. SPECIAL PROJECT: Evaluation of two categories of possible groundwater contamination: licensed hazardous waste generators and Ramsey County unpermitted dump site inventory.

St. Paul-Ramsey County, through its Department of Public Health, regulates solid and hazardous waste management in accordance with State law and County's solid and hazardous waste ordinances. This includes licensing and regular inspection of over 1,800 businesses that generate hazardous waste, and a number of solid waste transfer stations and facilities. The potential for a release of contamination into the environment by a waste generator is influenced by several risk factors, including the type and quantity of waste and the handling procedures used. While the Department is confident that generators are in compliance with applicable waste handling laws, it is possible that a release of contamination affecting soil and groundwater could go unaddressed.

Further, Ramsey County has information regarding a variety of dump sites in Ramsey County. The County has maintained this inventory since the 1980's and has field verified locations and to the best of its ability characterized the wastes in those dumps. The majority of those dumps are demolition debris or brush. A few of the dumps on the Ramsey County inventory are also on the MPCA's unpermitted dump list as well. The list of County sites needs to be reviewed to separate the minor littering violations from those that could pose a risk to groundwater, specifically drinking water supplies.

RECOMMENDATIONS

- It is recommended that a joint review of hazardous waste generators and Ramsey County dumps be conducted to assess whether further action is needed to investigate or intervene to protect public water supplies. This evaluation would involve consideration of a risk-based approach to licensing and inspection. This review should involve as many of the following public agencies as necessary: the Saint Paul – Ramsey County Department of Public Health, MPCA, Minnesota Department of Health, public water supply agencies, and Ramsey Conservation District.

Cost:	This is a one-year RCD budget item totaling $25,800. The time commitment and costs that the St. Paul-Ramsey County Department of Public Health could incur for meetings and file reviews are expected to be minor.
Funding Sources:	To be determined as per Section 5.4
Benefit:	Knowing the location of specific groundwater contaminant sources and plumes is basic to groundwater protection. It forms the basis of knowing where threats are coming from.
Leadership:	Ramsey Conservation District
Partners:	MPCA, Minnesota Department of Health, Saint Paul – Ramsey County Department of Public Health
Timeline:	1 year to complete

Reporting: RCD will issue report and map sites in GIS format. Updates would have to be addressed as needed.

GROUNDWATER PROTECTION INITIATIVES (continued)

9. SPECIAL PROJECT: Review of MPCA files related to approximately 80 unpermitted dumps in Ramsey County to look for indications of groundwater impacts.

According to the MPCA, 80 old unpermitted dumps exist in Ramsey County. Only the Fish Hatchery Dump and the Pigs Eye Landfill have been investigated for groundwater contamination by the MPCA. Some of the unpermitted dumps have been listed as Voluntary Investigation and Cleanup (VIC) sites at the owner's request and had work performed to determine the extent and magnitude of contamination.

Other than the MPCAs Dump Assessment Study in 2001, no work has been done to follow up on the remaining 78 unpermitted dumps to determine whether or not they pose a threat to the drinking water supply and groundwater dependent resources in Ramsey County. Ramsey County would benefit from further review of the MPCAs files to determine if threats exist to groundwater.

RECOMMENDATIONS

- It is recommended that a joint review of hazardous waste generators and closed, unpermitted dumps be conducted to assess whether further action is needed to investigate or intervene to protect public water supplies. This review should be conducted in association with the public agencies involved, including the MPCA, Minnesota Department of Health, Saint Paul – Ramsey County Department of Public Health, cities, and Ramsey Conservation District.

- It is recommended that a file review be done to identify what waste streams were sent to these dumps and make a determination of what threat they may pose. This would require making a request for files from the MPCA, review of those files at their offices, and documenting the results of the review.

- If evidence of a potential threat was found, the MPCA would be contacted to determine whether or not a subsurface investigation was warranted. If so, the responsibility for the investigation would rest with either the MPCA or any identifiable responsible party.

Cost:	This is a one-year RCD budget item totaling $31,650. Partner funding has been secured.
Funding Sources:	To be determined as per Section 5.4
Benefit:	Definition of potential groundwater threats from old dumps would allow potential contaminant sources to be addressed before they impacted water supplies.
Leadership:	Ramsey Conservation District Groundwater Partnership
Partners:	St. Paul-Ramsey County-Public Health and MPCA
Timeline:	Start 2010
Reporting:	RCD will issue report and map sites in GIS format.

GROUNDWATER PROTECTION INITIATIVES (continued)

10. SPECIAL PROJECT: Assemble GIS database of stormwater infiltration structures that could pose threats to groundwater in emergency response spill situations.

Redevelopment of properties in Ramsey County often involves meeting requirements by cities and water management organizations to infiltrate more stormwater. This is an attempt to reduce the volume of water moving through municipal stormwater systems. Space restrictions often dictate that subsurface stormwater systems be installed. Such systems infiltrate stormwater from nonpoint sources. Rainfall or snowmelt moving over and through the ground carrying natural and human-made pollutants into lakes, rivers, streams, wetlands and ground water causes nonpoint source pollution.

Most below-grade infiltration structures are inconspicuous enough that no one, other than the property owner, would suspect their presence**.** These systems are recorded on property deeds but no systematic way of locating them currently exists.

For the sake of emergency spill response, these systems should be mapped and accounted for. Emergency responders could access a GIS map showing the systems so that barriers could be installed at inlets to protect contaminants from entering groundwater.

RECOMMENDATIONS

- Gather information the locations of these structures and maintain it in case an emergency response situation occurs where chemicals have flowed into this type of underground structure. All stormwater structures, as well as their inlets and outlets, should be mapped in this manner and the data would be accessible in a secure manner online through the Ramsey County GIS User Group.

Cost:	This is a one-year RCD budget item totaling $20,600. Partner funding has been secured.
Funding Sources:	To be determined as per Section 5.4
Benefit:	Emergency responders need this type of information to protect the environment in situations where chemical releases could flow to subsurface infiltration structures and impact groundwater.
Leadership:	Ramsey Conservation District
Partners:	Watershed districts/WMOs, cities, the proposed Ramsey County Groundwater Partnership, and Ramsey County Emergency Management & Homeland Security
Timeline:	Start 2010
Reporting:	RCD will issue report and map sites in GIS format.

GROUNDWATER PROTECTION INITIATIVES (continued)

11. Encourage Metropolitan Council and MPCA to proceed with contaminated soil and groundwater plume mapping project for the 11-county metro area.

Early in the planning process for the Ramsey County Groundwater Protection Plan, the Technical Advisory Committee drew attention to the need for a contaminated soil and groundwater plume mapping project for Ramsey County. This work is known to have been done by Dakota County, in association with the Metropolitan Council.

A GIS formatted database showing areas of contamination would be a significant planning and development tool that would allow known areas of contamination to be avoided when stormwater was being infiltrated. Addressing this need at a metropolitan scale would be far more useful and efficient than working county by county. Keeping the database current would also be far easier if it was done metro-wide, rather than county by county.

RECOMMENDATIONS

- All of the partners and Technical Advisory Committee members that worked on the Ramsey County Groundwater Protection Plan encourage the Metropolitan Council and MPCA to proceed with a proposed contaminated soil and groundwater plume mapping project for the 11-county metro area.

- Groundwater Partners will provide any relevant data and RCD will provide information from file review of MPCA's unpermitted dumps and County dump site list.

Cost:	No apparent local cost.
Funding Sources:	Not applicable
Benefit:	Knowing the location of specific groundwater contaminant sources and plumes is basic to groundwater protection. It forms the basis of knowing where threats are coming from and allows stormwater infiltration to be directed away from existing contamination.
Leadership:	Ramsey County Groundwater Partnership
Partners:	Not applicable
Timeline:	Not applicable
Reporting:	Not applicable

GROUNDWATER PROTECTION INITIATIVES (continued)

12. Stormwater reuse should be emphasized by water organizations.

Reuse of stormwater reduces high flow events in streams following rain events or spring thaws. This in turn reduces sediment load, stream bank erosion, and nutrient concentrations in stormwater. Use of stormwater for irrigation enhances infiltration of water and recharge of groundwater aquifers. A one inch storm produces over 500 gallons of water on a 1,000 square foot roof.

Stormwater reuse structures are anticipated to be stormwater cisterns designed for public and private new development or major redevelopment projects in Ramsey County. Capturing stormwater allows particulate and nutrients (phosphorus) to settle out and for the water to have a beneficial reuse, such as for watering a "green roof" or for large-scale irrigation of lawns, plantings, or parks.

Reuse of stormwater saves the valuable groundwater resource for its intended purpose; drinking water.

RECOMMENDATIONS

- Where technically and financially feasible, water organizations should adopt stormwater reuse techniques and seek cost-sharing opportunities with regional and state funding sources such as the Metropolitan Council and the Board of Soil and Water Resources. This would be a separate effort from existing stormwater volume reduction and cost-share programs.

Cost: Project specific costs to permitees. Capital costs vary based on project size. Examples:
- Office tower 65,000-gallon stormwater cistern cost approximately $175,000.
- City of St. Anthony's 500,000-gallon stormwater cistern cost over $1,000,000.

Funding Sources: Permitees
Benefit: Reduction of groundwater usage, nutrients in stormwater, and peak flows.
Leadership: Watershed districts/WMOs and cities in their permitting process.
Partners: Ramsey Conservation District
Timeline: Start 2010
Reporting: RCD Annual Groundwater Report will include update information.

GROUNDWATER PROTECTION INITIATIVES (continued)

13. Stormwater infiltration should be directed away from contaminated soils or known areas of groundwater contamination.

In recent years, water management organizations have required permitees to infiltrate larger volumes of stormwater rather than direct it to municipal stormwater systems. This reduces the load of sediment and contaminants to surface water bodies like lakes and streams, as well as reducing the peak flows in streams that contributes to stream bank erosion.

This practice is counterproductive if stormwater infiltration is directed to areas of contaminated soils or known groundwater contamination. Infiltrated stormwater to contaminated areas may mobilize soil contaminants. The subsequent contamination may cause off-site groundwater and soil vapor impacts to other businesses and neighbors.

Permitting agencies will send final infiltration designs to RCD for inclusion in a GIS format database to be kept current for emergency response and planning purposes.

RECOMMENDATIONS

- Stormwater infiltration is should be directed away from contaminated soils. Water organizations or cities will direct developers to prove soil is clean by requiring the submittal of a Phase I Environmental Site Assessment (ESA) and/or documenting of soil conditions with a soil boring and soil vapor headspace reading or laboratory analytical analysis for the compounds of concern. This level of screening is unnecessary within public rights of way unless previous polluting land use activities are suspected or soil borings provide some visual or other sensory warning of pollution.

- In addition, it is recommended that stormwater permit granting agencies evaluate project locations for proximity to wellhead protection areas. The Minnesota Department of Health's document "Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas" (Appendix E) should be consulted before infiltration projects move forward.

Cost:	Laboratory analysis (soil): approximately $100-200 Existing Phase I ESA: typically already completed for lending institution by property owner
Funding Sources:	Property owner
Benefit:	Avoid causing inadvertent migration of soil contaminants to groundwater.
Leadership:	Watershed districts/WMOs and city permitting agencies.
Partners:	Ramsey Conservation District and Ramsey County Groundwater Partnership
Timeline:	Start 2010

Reporting: RCD Annual Groundwater Report will include update on number and location of infiltration sites installed.

GROUNDWATER PROTECTION INITIATIVES (continued)

14. Water management organizations should identify and map groundwater dependent natural resources in order to protect them from degradation due to potential groundwater level declines.

Many surface water resources such as lakes, streams, springs, and wetlands are dependent on groundwater flow for their existence. This means that flows and water elevations in these resources could be reduced due to land use changes and reduced stormwater infiltration, leading to alteration of these ecosystems. This effort would develop tools for planners and water-resources managers that will assist them in making decisions that will balance land-use needs with the protection of groundwater and surface-water resources.

Some watershed management jurisdictions in Ramsey County have already begun or completed assessments of groundwater dependent natural resources.

RECOMMENDATIONS

- For those water management jurisdictions that have not completed them, conduct groundwater dependent natural resource evaluations to determine the relationship between surface water features and groundwater. This could take the form of a comparison between the regional water table elevation and the elevations of surface water features. Washington County has completed these evaluations for the north and south halves of that county.

- Conduct research to inventory and develop a priority ranking system for the groundwater recharge and discharge functions of lakes, wetlands, and land areas. Make identification and ranking of groundwater recharge areas a priority element of water management jurisdiction local wetland and natural resource inventories.

- The various water management organizations in Ramsey County are at different stages in identification and mapping of groundwater dependent resources. Discussions among the members of the proposed Ramsey County Groundwater Partnership are recommended to determine if a wetland located on a jurisdictional boundary could be assessed jointly.

- Monitoring of surface water and groundwater at these resources should be undertaken on an individual, as needed, basis.

Cost: Costs to conduct these types of assessments vary depending on how developed the areas currently are. Generally, the more developed an area is, the less time it might take to conduct these studies. A general cost of $500 per square mile for conducting the assessment can be used as an estimate. Additional fieldwork could be required to determine a resource's dependence on groundwater. Individual water management

jurisdictions in Ramsey County are at different stages of wetland assessment, so it is not possible to put a precise figure on conducting assessments of their respective groundwater dependent resources. As an example, in 2007 Washington Conservation District (WCD), working in conjunction with Valley Branch Watershed District and Barr Engineering, began a $170,000 Wetland Function and Values assessment on approximately 1,400 wetlands and budgeted 1,100 hours over the span of two years for field assessment work. WCD did the Wetland Function and Values assessment after conducting an "enhanced Minnesota Land Cover Classification System (MLCCS) evaluation" down to a ¼-acre scale.

Funding Sources: Watershed districts/WMOs/grants
Benefit: Awareness of surface water/groundwater interaction and protection of groundwater dependent resources
Leadership: Watershed districts/WMOs
Partners: Ramsey County Groundwater Partnership
Timeline: Depends on water management jurisdiction
Reporting: RCD Annual Groundwater Report

GROUNDWATER PROTECTION INITIATIVES (continued)

15. Support open space as a land use that protects groundwater as well as providing other benefits to the public.

Open space has aesthetic aspects but in addition is a valuable factor in groundwater protection. Open space a valuable offset to other, more intensive land uses (i.e., commercial or industrial development) that carry with them risks of both point and non-point source pollution.

Since groundwater quality and groundwater recharge benefit from open space, they represent additional reasons why open space can be supported when making land use decisions.

RECOMMENDATIONS

- Groundwater quality and quantity issues will benefit from countywide support of open space. This effort can help advance efforts to provide parkland, habitat, and low-impact development in Ramsey County.

- The Minnesota Land Cover Classification System (MLCCS) can be utilized to identify areas of available open space. The DNR Metro Greenways Program and Natural Heritage Program should be evaluated to assess opportunities for additional groundwater recharge, as well as to provide other resource protection benefits.

- The planning process for open space placement should also consider the locations of DWSMA boundaries around drinking water supply wells. Citing open space in these DWSMAs would be protective of groundwater quality in these areas.

Cost:	Costs associated with creating open space involve unknown real costs and opportunity costs. Tangible costs could include land purchase and upkeep. Opportunity costs would be compared to the economic benefit of developing a property.
Funding Sources:	The effort could be linked to potential habitat preservation projects funded through the Lessard-Sams Outdoor Heritage grants from dedicated sales tax funds.
Benefit:	Groundwater protection and enhances infiltration due to less intensive land use. Additional habitat benefits as well.
Leadership:	Cities' Planning Departments/water providers
Partners:	Ramsey Conservation District and Ramsey County Groundwater Partnership
Timeline:	Start 2010
Reporting:	When available, the RCD's Annual Groundwater Report will include published data from Metropolitan Council land use inventory to track increase or decrease of this land use.

GROUNDWATER PROTECTION INITIATIVES (continued)

16. County adoption of State of Minnesota code for Individual Sewage Treatment Systems in order to assure adequate dispersal and treatment of domestic sewage before it infiltrates to groundwater.

A recent change in State law requires counties to adopt the MPCA's rules for Individual Sewage Treatment Systems (ISTSs), and assure that municipal ordinances are consistent with those standards. The St. Paul - Ramsey County Department of Public Health is preparing an ordinance for consideration by the County Board, with adoption slated by February 2010.

There are about 1,800 septic systems in 13 of the 17 municipalities in Ramsey County. The number ranges from 1,240 in North Oaks, to 1 in Mounds View. With the County's adoption of an ordinance incorporating MPCA standards, and assurance that municipal ordinances are consistent, regulation of ISTSs will be standardized in the County. Cities can then administer these standards to correct failing systems and assure proper maintenance and new construction.

This will be protective of groundwater by eliminating or reducing the pathogens and nutrients carried in sewage from infiltrating down to groundwater.

RECOMMENDATIONS

- St. Paul - Ramsey County Department of Public Health is in the process up updating their ISTS ordinance. Their effort has the support of this planning effort.

Cost:	The original design and installation cost of an individual on-site septic system typically ranges from $3,000 to greater than $10,000, depending on the size of home, the site conditions, and local ordinance requirements. In unusual circumstances, some can cost even more.
Funding Sources:	Minnesota Department of Agriculture - Best Management Program, 3% APR loan program
Benefit:	Reduce the risk of groundwater contamination from ISTS wastes.
Leadership:	St. Paul - Ramsey County Department of Public Health
Partners:	Ramsey Conservation District and municipalities
Timeline:	2010
Reporting:	RCD Annual Groundwater Report will include update information.

5.2 ISSUES FOR FUTURE CONSIDERATION

The DNR has noted that between 15 and 20 percent of Ramsey County residents rely solely on groundwater for their water supply, while the balance are supplied by the St. Paul Regional Water Services. This indicates that when a severe drought occurs, ±80% of the County's population will be impacted by Mississippi River flow restrictions. As Rule 6115.0660 Subp. 3G notes, a contingency plan must be developed to describe alternative appropriation is surface water use is restricted. The St. Paul Regional Water Services has an approved Water Supply Plan (WSP) that addresses this and has installed wells as a part of this contingency plan to provide a water supply to supplement the river water source.

Should this occur, groundwater appropriation would increase, and groundwater would supply, at least temporarily, 100% of the population. This has the potential to affect groundwater withdrawals in the northern half of Ramsey County as well as affecting water flow in many streams, rivers, and lakes. Consideration should be given to a review of the WSP for each community and their incorporation into the St. Paul Regional Water Services' WSP in order to determine present and future water appropriation sources and needs, as well as groundwater dependant resources noted in their plans.

5.3 COST OF GROUNDWATER PROTECTION INITIATIVES

The costs and employee resources to fulfill the initiatives are shown below. Separate lines are provided for proposed one time project capital costs (groundwater quality and elevation monitoring) and ongoing annual costs. The budget projections in Table 7 extend for 10 years; to 2019.

Some of the initiatives are ongoing annual efforts while others are onetime special projects. Special projects, such as mapping of stormwater infiltration structures and the unpermitted dump file review; will require approximately 25 percent of RCD's Groundwater Specialist's time. The special projects would be undertaken one at a time and their sequence would have to be determined through consultation among groundwater partners.

PROGRAMS	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Water level monitoring program	$12,750	$12,750	$13,133	$13,526	$13,932	$14,350	$14,781	$15,224	$15,681	$16,151
Water quality monitoring program	$12,750	$12,750	$13,133	$13,526	$13,932	$14,350	$14,781	$15,224	$15,681	$16,151
Special Project 1 (GIS database of below-grade stormwater structures)	$20,600	-								
Special Project 2 (Review MPCA files on 80 unpermitted dumps)		$31,650								
Special Project 3 (Evaluate Co. Haz. Waste Generators/Co. Dumps)	$25,800									
Other Special Projects			$21,888	$22,544	$23,220	$23,917	$24,635	$25,374	$26,135	$26,919
Groundwater leadership/education & outreach/database upkeep	$29,750	$29,750	$30,643	$31,562	$32,509	$33,484	$34,488	$35,523	$36,589	$37,686
Well Sealing - Annual Program	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Supplies	$1,000	$1,000	$1,030	$1,061	$1,093	$1,126	$1,159	$1,194	$1,230	$1,267
Subtotal:	$102,650	$87,900	$79,825	$82,220	$84,686	$87,227	$89,844	$92,539	$95,315	$98,175
OUTSIDE PURCHASES										
Water level monitoring (pressure transducer purchase)	$9,500	$9,500	-	-	-	-	-	-	-	-
Water quality monitoring (Laboratory analytical)	$13,000	$26,000	$26,780	$27,583	$28,411	$29,263	$30,141	$31,045	$31,977	$32,936
Total:	$125,150	$123,400	$106,605	$109,803	$113,097	$116,490	$119,985	$123,584	$127,292	$131,111

Note: Assumes 3% annual increase

Table 7 - Program Costs

5.4 FUNDING SOURCES FOR IMPLEMENTATION

Stable funding sources must be found to support the long-term protection of this local groundwater resource. The key to this Plan is to have a countywide organization to institutionalize implementation of the programs and initiatives it contains. This will be a capacity building step toward managing the groundwater resource.

As stated in Section 1.3 Guiding Principles on page 4, how and when possible, water management jurisdictions (watershed districts and joint powers water management organizations) and public water providers are anticipated to be the primary financial resource for groundwater protection implementation in Ramsey County,. Ramsey County, through its Conservation District, should coordinate protection initiatives and seek to secure State and Federal funding opportunities.

The State statutes that pertain to groundwater management responsibility are included in Section 1.11 on page 14. These statutes direct that Watershed Plans and municipal Water Management Plans must conform to County Groundwater Plans. Thus, when a County Groundwater Protection Plan is approved, it affects both Watershed Plans and municipal Water Management Plans.

The funding for the Ramsey Conservation District's current groundwater planning efforts and the Groundwater Specialist position came from the County and various water management organizations. Funding was for writing this Plan. The planning process and funding started in June 2008 and lasts for 18 months; ending in December 2009.

Total annual costs for each of the 2010 and 2011 are $125,150 and $123,400, respectively, and include the following:

- RCD staff coordinates the Plan activities and is integral to completing monitoring activities and special projects.
- Annual abandoned (unused) well sealing cost share program participation and qualification details are left to the discretion of the funding partners. Some may manage their own programs and others may administer theirs through RCD.
- Annual groundwater quality monitoring project laboratory analysis costs are $13,000 in 2010 and $26,000 in 2011.
- Continuous groundwater elevation monitoring (capital expense for pressure transducers) in observation wells; costs are $9,500, in 2010 and 2011.

Capital expenses for the groundwater elevation monitoring equipment purchase are $9,500 for each of first two years. RCD staff time is required to install and collect data from this equipment.

Anticipated budgets for the following eight years (2012 to 2019) are estimates and could change if the proposed Ramsey County Groundwater Partnership determines that additional specific projects should be undertaken or if priorities change.

Ramsey County, the 2008 Clean Water Land and Legacy Amendment sales tax funds, groundwater protection authorities, water management organizations, and municipalities are all possible sources of funding for the groundwater protection programs proposed in this Plan. Discussions between the groundwater protection partners will need to take place to determine financial commitments for Plan implementation. It is anticipated that funding will come through a variety of sources, channeled through a countywide organization such as the RCD. The recommended participation by watershed districts, WMOs, water providers is as follows:

- Watershed districts/WMOs 1 -19 % each (based on land area)
    - Capital Region Watershed District
    - Ramsey Washington Metro Watershed District
    - Rice Creek Watershed District
    - Vadnais Lake Area Water Management Organization
    - Grass Lake Water Management Organization
    - Valley Branch Watershed District

- Water providers 19% (combined)

At the time of the writing of this Plan, the Ramsey Washington Metro Watershed District Board of Managers has passed a resolution approving up to $21,000 (19% of the total budget) for groundwater protection implementation for each of the years 2010 and 2011.

The recently adopted Clean Water Land and Legacy constitutional amendment that established both a Clean Water Fund and an Outdoor Heritage Fund are still in their formative stages. This new legislation has a requirement that at least 5% of the Clean Water Fund's revenue must be spent on drinking water protection. It is clear that the Clean Water Council's vision assumed that local partnerships are critical to the effective implementation of solutions and that resource monitoring, prevention, and measureable outcomes are among their highest priorities. This Plan fits those goals. Money from those funds is not anticipated to be available for distribution until mid-2010. RCD, with the financial commitment of watershed districts, applied for grant funding through the Clean Water Partnership, administered by the MPCA.

County government is best positioned to protect groundwater and has the greatest opportunity to achieve it through partnerships with cities, water supply authorities, water management organizations, the Metropolitan Council, and state agencies. Ramsey County Board of Commissioners and the Ramsey Conservation District Board of Supervisors has shown commitment and leadership by dedicating part of RCD's budget toward groundwater protection.

This Plan conveys the message of aquifer vulnerability in the face of current and future land use, as well as the sense that more needs to be known about the quality and quantity of groundwater in Ramsey County. Management of this vital resource is not possible without public investment. This Plan establishes the framework to move forward with groundwater protection.

The Ramsey Conservation District, which lacks taxing authority, has limited funding for its' conservation programs but has placed groundwater protection as the number one priority. Identification of other sources of funding is ongoing.

Without adequate commitment and funding for this Plan's implementation, our shared groundwater resources face increasing threats to quality and quantity. The status quo is not sustainable.

Ramsey Conservation District, as the author of this Plan, has the ability to lead implementation of the Plan. Following Ramsey County plan adoption, the cooperative institutional structure for protecting Ramsey County's groundwater will be put in place.

List of Acronyms

BWSR	**Board of Water and Soil Resources**
CERCLIS	**Comprehensive Environmental Response, Compensation, and Liability Information System** (Superfund Site Information on hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation, including sites that are on the National Priorities List (NPL) or being considered for the NPL.)
DNR	**Department of Natural Resources**
DWSMA	**Drinking Water Supply Management Area**
GIS	**Geographic Information System**
ISTS	**Individual Sewage Treatment System**
MDH	**Minnesota Department of Health**
MPCA	**Minnesota Pollution Control Agency**
NFRAP	**No Further Remedial Action Planned** (sites that have been removed from the CERCLIS list by the EPA. These sites are no longer considered a federal concern, and most are also a low priority for the state.)
NPL	**National Priority List** (list of hazardous waste sites in the United States eligible for long-term remedial action financed under the federal Superfund program.)
PFC	**Perfluorochemical**
PLP	**Permanent List of Priorities** (MPCAs' hazardous waste sites where investigation and cleanup are needed, cleanups are underway, or cleanup has been completed and long-term monitoring or maintenance continues.)
PSW	**Permitted Solid Waste** sites (facilities that manage solid waste (household or business garbage). Among the types of facilities included are landfills, transfer stations, demolition landfills, composting facilities and solid-waste incinerators.)
RCD	**Ramsey Conservation District**
RCRA	**Resource Conservation and Recovery Act** (Federal program that tracks the progress of hazardous wastes from their point of generation, their transport, and their treatment and/or disposal.)
TAC	**Technical Advisory Committee**
USGS	**United States Geological Survey**
VIC	**Voluntary Investigation and Cleanup sites** (MPCA)
WPA	**Wellhead Protection Plan**

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Appendix A

Water Resources Management in Minnesota

Freshwater Society

Water Resources Management in Minnesota

Drinking Water Safety

Management Roles

In Minnesota, the federal government, state agencies, and local units of government have responsibility for regulating drinking water. At the federal level, the Environmental Protection Agency (EPA) is involved by administering the Safe Drinking Water Act. At the state level, the Department of Health (MDH) is the primary agency regulating drinking water. The other agencies involved are the Department of Agriculture (MDA), Pollution Control Agency (PCA), and Board of Water and Soil Resources (BWSR). Local entities are also involved, including counties and municipalities, and Soil and Water Conservation Districts (SWCDs). In Minnesota, regulations are imposed through statutes, rules, ordinances, and permits and state agencies directly regulate activities or delegate regulatory responsibility to local entities.

Federal Government

The Safe Drinking Water Act & Environmental Protection Agency. The Safe Drinking Water Act (SDWA) was passed to regulate the nation's public drinking water supply. The law requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and ground water wells (does not regulate private wells which serve fewer than 25 individuals). The original law focused primarily on treatment to provide safe drinking water. The 1996 amendments added source water protection, operator training, funding for water system improvements, and public information responsibilities. The SDWA authorizes the EPA to set national health-based standards for drinking water. These National Primary Drinking Water Regulations set enforceable maximum contaminant levels in drinking water, and requirements for water systems to test for contaminants. The EPA, states, and water system suppliers are responsible for making sure standards are met. The most direct oversight of water systems is conducted by state drinking water programs that must adopt standards at least as stringent as the EPA's.

Department of Health. The MDH is the main agency designated to protect drinking water supplies under the SDWA. These responsibilities include:

- testing and inspecting public water supplies
- setting state standards for drinking water supplies
- evaluating health effects of contaminants in drinking water
- providing advice on drinking water treatment devices
- testing bottled water

Drinking Water Standards

To regulate drinking water quality of public water supply systems, the MDH enforces standards set by the EPA and health risk limits set by the MDH. Public water suppliers are responsible for taking some of the required water samples, according to a schedule determined by the MDH. MDH staff collect the remainder of the required samples. Certified laboratories test the water samples for a broad variety of possible contaminants and information is reported to the MDH. Systems are tested on a regular basis for:

- Bacterial contamination
- Pesticides and industrial contaminants
- Nitrate
- Inorganic chemicals and radiological elements
- Disinfection by-products
- Lead and copper

A water supplier must take corrective actions which include notifying its water users of a problem if a contaminant level exceeds standards and implementing corrective actions.

The MDH administers a mandatory certification program for public water supply system operators under M.S. Chapter 115 and Minnesota Rules Chapter 9400. Operators are trained on operating procedures, treatment processes, equipment and maintenance, management, and state law and rules relating to water. Operator certifications are valid for three years and can be renewed at expiration.

Source Protection

In order to protect public drinking water supplies from contamination, the MDH operates Minnesota's Source Water Protection Program under the SDWA. Wellhead Protection and Source Water Assessments are the two primary parts of this program.

Wellhead Protection is a regulation to protect the water quality in public water supply wells (M.S. 103I.101). States are required to have wellhead protection programs under the provisions of the 1986 amendments to the federal Safe Drinking Water Act. The MDH administers the state wellhead protection rule (Minnesota Rules, Chapter 4720.5100-4720.5590) that sets standards to protect wellheads thorough wellhead management plans. Public water suppliers are required to delineate, inventory, and manage an inner wellhead management zone. They must also create a formal wellhead protection plan, which has two parts:

- Delineation of the wellhead protection area and drinking water supply area, and assessment of the vulnerability of the well or well(s) to contamination

- Creation of a wellhead protection plan itself, including goals, objectives, plan of action, evaluation program, and contingency plan

The wellhead protection area is determined by using geologic and hydrologic criteria, such as the physical characteristics of the aquifer and the effects which pumping has on the rate and direction of ground water movement. Through this process a well capture area is designated and a management plan for possible contamination sources is developed and implemented. The MDH assigns staff to assist public water suppliers with preparation and implementation of plans.

Source Water Assessments are reports that provide a description of the water source used by a public system and discuss contamination susceptibility of the source. The 1996 amendments to the federal Safe Drinking Water Act require states to produce source water assessments for all their public water systems, and to make the results available to the public. These assessments include an analysis of the sensitivity of a source water body by studying the:

- physical properties of the geologic setting or landscape within the watershed
- topography, hydrology, geology, vegetation, and the distribution of various soil types within the sub-watersheds

These assessments are completed by public water suppliers in partnership with the MDH and other entities depending on the water source. For example, the City of St. Paul Regional Water Services completed their assessment in partnership with the Ramsey Conservation District, Metropolitan Council, US Geological Survey, Rice Creek Watershed District, Vadnais Lake Water Management Organization, Mississippi River Defense Network, and Rivers Council of Minnesota. Assessments have been completed for all of the approximately 7,000 public water supply systems, ranging from small businesses with their own wells to large city water systems using several sources of water. These reports are updated as new information is added, such as well construction data, to the databases used to generate the assessments, and are posted for public viewing on the MDH's Website.

<u>Well Regulations</u>

About one million people in Minnesota rely on private wells for their water and about three million are served by public water systems which provide ground water from public wells. Under M.S. 103I.101 the MDH regulates and oversees well construction and sealing procedures. The MDH's Well Management Program, through the Minnesota Well Code (M.S. 103I):

- Establishes standards for construction and sealing of wells and borings
- Licenses contractors who construct, repair, and seal wells and borings

- Administers permits and notifications to construct and seal wells and borings
- Inspects the construction of new wells and borings, and the sealing of old wells and borings
- Assures that unused wells are sealed following property transfers
- Maintains records on wells and borings
- Provides information, training, and technical assistance to contractors, other professionals, and the public
- Responds to well and well water quality problems caused by ground water contamination events and natural disasters such as floods

All wells must be installed by contractors licensed by the MDH (all well drilling contractors must be licensed by the state), except that an individual may construct a drive point well for personal use on land owned or leased by that individual, and used for farming or agriculture or for the individual's residence. In either case, the well must be constructed according to the requirements of Minnesota Rules Chapter 4725 which describe the necessary procedures for wells. Retail sellers of drive point wells must provide buyers with notification forms and informational materials including requirements regarding wells, their location, and construction. A notification form and fee must be submitted to the MDH by the well owner or contractor before well drilling begins. The well contractor must have a water sample tested for bacteria and nitrate by a MDH certified laboratory and send results to the well owner. A well boring record that describes well attributes such as depth, depth to ground water, geology, well components, and pump information is sent to the MDH and given to the well owner. Well information is compiled into the County Well Index Online which is developed by the Minnesota Geological Survey and the MDH. The index is a database that contains information such as location, depth, and static water level for existing wells. Mapping of wells onto aerial photos allows users to visually identify well locations.

The MDH also regulates wells by administering M.S. 103I.235 which requires the process of well disclosure during a property transfer. The property seller must provide information about the location and status of all types of wells to the buyer and the MDH. Any unused wells must be put back into use, sealed, or have a maintenance permit (allows an unused well to remain unsealed if it is properly maintained). If one of these steps is not taken at the time of the property transfer, it is the responsibility of the buyer to implement one of these actions.

Department of Agriculture. New wells and existing wells used for irrigation with pesticides or fertilizers (chemigation) are required to be approved by the MDA. Under M.S. 18B.08 and M.S. 18C.205, the MDA requires permits for chemigation and that the system be fitted with effective antisiphon devices or check valves that prevent backflow of pesticides or fertilizers into water supplies during irrigation failure or equipment shutdown.

Pollution Control Agency. The PCA administers the Closed Landfill Program which is a voluntary program to properly close, monitor, and maintain closed municipal sanitary landfills. PCA staff develop land management plans that are required under M.S. 115B.412 of the Landfill Cleanup Act. Local government's land use designations and zoning ordinances must follow the PCA's land management plans and may restrict new well instillation within the landfill's permitted boundaries. If ground water supplies become contaminated, the PCA under M.S. 103H.251 and M.S. 103H. 275, is responsible for investigating the pollution source and minimizing or preventing the pollution to the extent possible.

Board of Soil and Water Resources. Through the State Cost-Share Program, BWSR grants funds to SWCDs for sealing unused wells.

Local Entities

Counties & Municipalities. The MDH has delegated the responsibility of regulation of water wells, monitoring wells and/or dewatering wells to some local boards of health under M.S. 103.111. Cities or counties that have responsibility for wells within their jurisdictions are the cities of Bloomington and Minneapolis, and the counties of Blue Earth, Dakota, Goodhue, LeSueur, Olmstead, Wabasha, Waseca, and Winona. Municipalities and counties have the same requirements for regulating public water supply systems as the MDH under the SDWA. Municipal drinking water suppliers are required to monitor water supplies for contaminants, prepare and distribute annual reports including information on contaminants detected, possible health effects, and the water source.

Soil and Water Conservation Districts. SWCDs work through the State Cost-Share Program to seal unused wells.

Appendix B

Unpermitted Dumps, Ramsey County

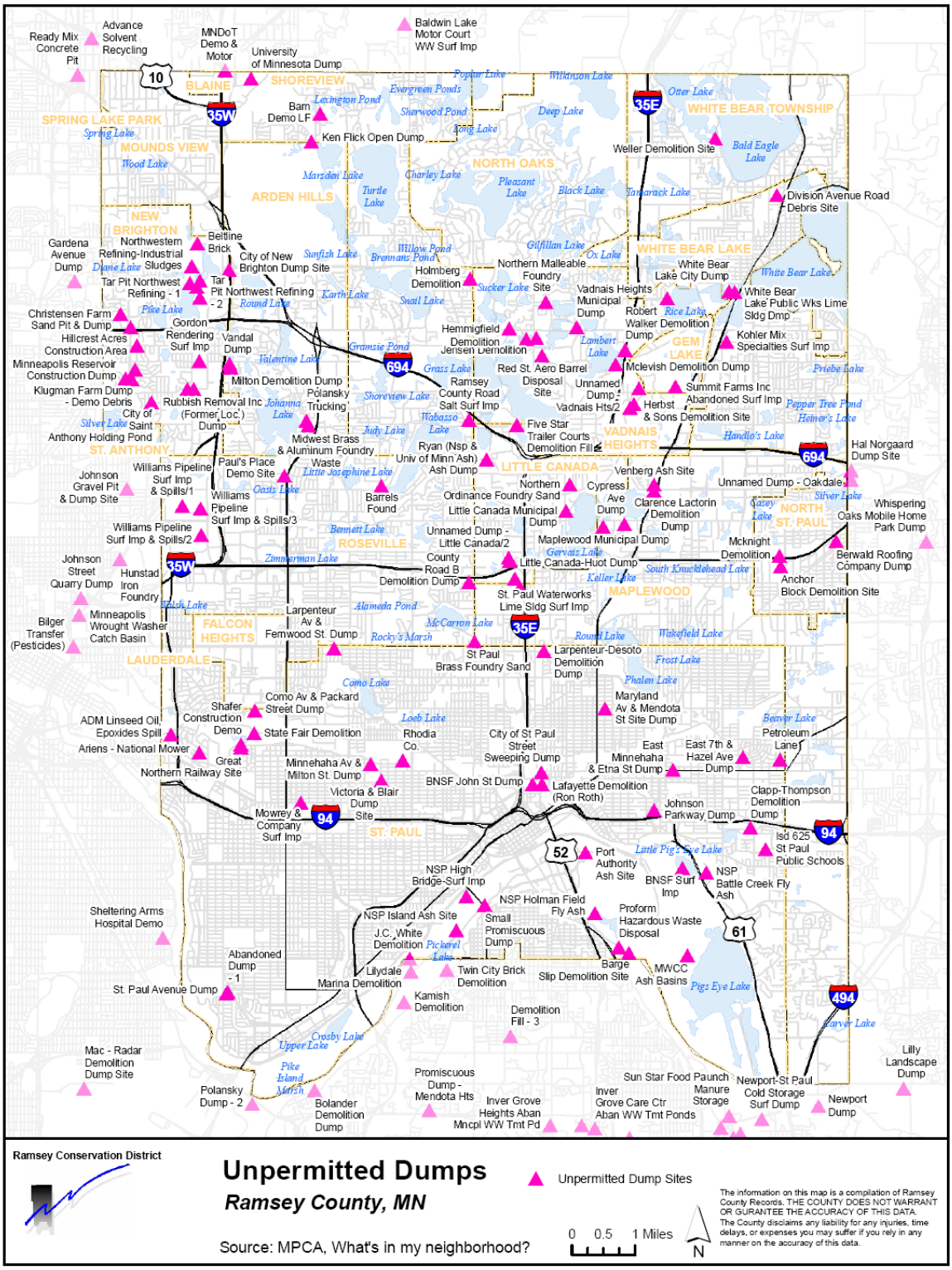

Figure 1 - MPCA Unpermitted Dumps

MPCA List of Unpermitted Dumps

	SiteID	Site Name	MES Link ID	Decision Date	Address	City Name
1	SA8350	SMALL PROMISCUOUS DUMP	839	19-Aug-98	East of Smith Street near Water Street	St. Paul
2	SA8349	PORT AUTHORITY ASH SITE	834	19-Aug-98	Between Bayfield Street & Riddler Circle	St. Paul
3	SA8348	NSP BATTLE CREEK FLY ASH	833	18-Aug-98	Between Hwy. #61 and Point Douglas Road	St. Paul
4	SA8351	NSP HOLMAN FIELD FLY ASH	843		"East of Lafayette Freeway, Southeast of	St. Paul
5	SA8345	CLAPP-THOMPSON DEMOLITION DUMP	830	27-May-98	West side of Ruth Street no Suburban Av	St. Paul
6	SA8344	JOHNSON PARKWAY DUMP	829	15-Jan-03	Johnson Parkway near Hwy. I-94	St. Paul
7	SA8343	LAFAYETTE DEMOLITION (RON ROTH)	824	13-Aug-98	"Between Arkright & Westminister St.,	St. Paul
8	SA8346	FISH HATCHERY DUMP	831	2-Jul-07	"North of Mississippi River, Southwest o	St. Paul
9	SA8353	BARGE SLIP DEMOLITION SITE	847	1-Sep-99	Between South Barge Channel Road and Con	St. Paul
10	SA8355	STATE FAIR DEMOLITION	935	27-May-98	N. of Pierce Butler Rt. & Fairview Ave.	St. Paul
11	SA8342	CITY OF ST PAUL STREET SWEEPING DUMP	823	7-Aug-98	Vic. of Arkright & Randall	St. Paul
12	SA8361	HOLMBERG DEMOLITION	956	19-May-98	"West side of Rice St, just south of Hwy	Shoreview
13	SA8327	NORTHWESTERN REFINING-INDUSTRIAL SLUDGES	723	18-Aug-98	Between Long Lake and Rush Lake Approx.	New Brighton
14	SA8362	HEMMIGFIELD DEMOLITION	957	19-May-98	NE quadrant of County Road F and RR cros	Vadnais Heights
15	SA8363	JENSEN DEMOLITION	958	19-May-98	SW quadrant of McMenemy Street and Count	Vadnais Heights
16	SA8364	PROMISCUOUS DUMP (Vandais Heights)	959	5-Apr-99	SE quadrant of McMenemy Street and Count	Vadnais Heights
17	SA8365	VADNAIS HEIGHTS MUNICIPAL DUMP	962	19-May-98	"On E 1/2 of land bounded by S Oak Rd,	Vadnais Heights
18	SA8366	WHITE BEAR LAKE PUBLIC WKS LIME SLDG DMP	963	22-May-98	1884 Whitaker	White Bear Lake
19	SA8368	ROBERT WALKER DEMOLITION DUMP	968	19-Aug-98	West Side of Centerville Road 1/3 mile S	Vadnais Heights
20	SA8369	MCLEVISH DEMOLITION DUMP	969	17-Aug-98	West of Centerville Road 1/2 Mile South	Vadnais Heights
21	SA8370	MINNESOTA LUMBER & WRECKING DEMO SITE	970	17-Aug-98	Just NW of Intersection of CoRd E & Labo	Vadnais Heights
22	SA8359	ST. PAUL AVENUE DUMP	943	22-Apr-98	Between Cleveland Avenue & St. Paul Ave.	St. Paul
23	SA8418	CITY OF NEW BRIGHTON DUMP SITE	1110	28-May-98	near 14th St & I-35W	New Brighton
24	SA4173	Old Minnehaha Dump		18-Aug-98	near Milton & Minnehaha	St. Paul
25	SA2007	3910 McMenemy		1-Sep-99	3910 McMenemy	Vadnais Heights
26	SA4510	Grand Avenue Development		22-Jul-03	1046 Grand Ave S	St. Paul
27	SA8330	CEMENT DUMP	729	6-Aug-98	"No of 694, NW of Cnty. Rd. #77, between	New Brighton

MPCA List of Unpermitted Dumps

28	SA4038	U of M Landfill		19-May-98	S. of Co. Rd. J & 1/4 mi. E. of I-35W	Shoreview
	SiteID	**Site Name**	**MES Link ID**	**Decision Date**	**Address**	**City Name**
29	SA8371	HERBST & SONS DEMOLITION SITE	971	19-May-98	SW of Co Rd E and Labore Rd Intersection	Vadnais Heights
30	SA4519	Old Highway 8 Barrel Dump		14-Feb-05	2032 Old Highway 8	New Brighton
31	SA8414	LARPENTEUR AV & FERNWOOD ST. SITE	3146	13-Aug-98	vicinity of the Larpenteur Av & Fernwood	St. Paul
32	SA8415	UNNAMED DUMP SITE (Vadnais Hghts)	4446	12-Jan-00	approx. 1/4 mi. SE of Co. Rd. E & I-35E	Vadnais Heights
33	SA8329	TAR PIT NORTHWEST REFINING	727	28-May-98	Between Old Hwy. #10 and Round Lake "Sou	New Brighton
34	SA4054	Kellog Blvd. Site		27-May-98	Kellog Blvd. near Lafayette Bridge	St. Paul
35	SA8341	LARPENTEUR-DESOTO DEMOLITION DUMP	820	13-Aug-98	SW Corner of Larpenteur Ave. & Desoto St	St. Paul
36	SA8419	EAST MINNEHAHA & ETNA ST SITE	3140	14-Apr-98	"Between Etna and Birmingham Streets, on	St. Paul
37	SA8422	HILLCREST ACRES CONSTRUCTION AREA	1112	15-May-98	near 23rd Ave & 7th St NW	New Brighton
38	SA8423	UNNAMED DUMP SITE (Little Canada)	4443	12-Jan-00	approx. 1/2 mi. so. of Demont Ave. and "	Little Canada
39	SA4387	Battle Creek Middle School Dump		21-Nov-00	2121 North Park Drive	St. Paul
40	SA4388	Mapleknoll Dump		1-Jan-02		Maplewood
41	SA8326	UNIVERSITY OF MINNESOTA LANDFILL	712	19-May-98	"S side of Co Rd J, 1/4 mi E of I-35W	Shoreview
42	SA8328	TAR PIT NORTHWEST REFINING (between Long Lk. & Round Lk.)	724	28-May-98	Between Long Lake and Round Lake Approx	New Brighton
43	SA8334	MILTON DEMOLITION DUMP	734	17-Aug-98	SE Corner of 35W and Soo Line Railroad C	New Brighton
44	SA8335	KAUSEL FOUNDRY DUMP	736	13-Aug-98	NE Corner of County Road E and 8th Ave N	New Brighton
45	SA8340	ST PAUL BRASS FOUNDRY SAND	819	14-Apr-98	NE of Rice St & Larpenteur Ave slightly	Maplewood
46	SA8416	DIVISION AVENUE ROAD DEBRIS SITE	3757	7-Aug-98	vicinity east of Division Street and sou	White Bear Lake
47	SA8400	MINNEAPOLIS RESERVOIR CONSTRUCTION DUMP	1116	17-Aug-98	W of 3rd St NW & Silver Lake Rd	New Brighton
48	SA8405	PAUL'S PLACE DEMO SITE	1125	15-May-98	SW of Snelling Ave & Lydia Ave	Roseville
49	SA8391	FIVE STAR TRAILER COURTS DEMOLITION FILL	1172	12-Aug-98	"N side of Twin Lake, near Twin Lake Rd	Vadnais Heights
50	SA8392	BARN DEMO LANDFILL	1105	1-Sep-99	"E side of Hamline Ave, approx. 1/4 mile	Shoreview
51	SA8432	LITTLE CANADA-HUOT DUMP	983	14-Aug-98	155 East Viking	Little Canada
52	SA8394	CHRISTENSEN FARM SAND PIT & DUMP	1109	28-May-98	S of 27th Ave & 14th St NW	New Brighton
53	SA8395	ABANDONED DUMP-MUNICIPAL WASTE	1111	15-May-98	near Bristol & Tioga Blvd	New Brighton
54	SA8396	CYPRESS AVE DUMP	1173	22-May-98	SE of Cypress St & Co Rd C	Maplewood

MPCA List of Unpermitted Dumps						
55	SA8397	BURLINGTON NORTHERN JOHN ST DUMP	1178	1-Sep-99	N of John St & Olmstead	St. Paul
56	SA8389	WELLER DEMOLITION SITE	1168	22-May-98	"W side of Bald Eagle Blvd, approx. 1/2	White Bear township
	SiteID	**Site Name**	**MES Link ID**	**Decision Date**	**Address**	**City Name**
57	SA8399	KLUGMAN FARM DUMP - DEMO DEBRIS	1115	15-May-98	near 3rd St NW & Silver Lake Rd	New Brighton
58	SA8390	NORTHERN MALLEABLE FOUNDRY SITE	1171	18-Aug-98	near Jay Way & Jay Circle	Vadnais Heights
59	SA8429	RED ST. AERO BARREL DISPOSAL SITE	960	23-Feb-00	1/2 mile SE of the intersection of McMen	Vadnais Heights
60	SA8401	OLD MILLER DUMP SITE	1119	19-Jun-00	"NE of I-694 & Old Hwy 8, approx 1/4 sq.	New Brighton
61	SA8402	VANDAL DUMP	1121	21-Aug-98	SE of Co Rd E2 & Cleveland Ave	Arden Hills
62	SA8412	VICTORIA & BLAIR DUMP SITE	3144	14-Apr-98	vicinity of the Victoria St & Blair St.	St. Paul
63	SA8411	MINNEHAHA AV & MILTON ST. SITE	3143	17-Aug-98	vicinity of the Milton St. & Minnehaha A	St. Paul
64	SA8409	MARYLAND AV & MENDOTA ST SITE	3141	14-Apr-98	vicinity of the Maryland Av and Mendota	St. Paul
65	SA8408	EAST 7TH & HAZEL AVE SITE	3139	14-Apr-98	"area boardered by Stillwater Av, Hazel	St. Paul
66	SA8407	NSP ISLAND ASH SITE	2175	18-Aug-98	"vicinity southeast of Shepard Road,	St. Paul
67	SA8398	KEN FLICK OPEN DUMP (GENERAL HOUSEHOLD	1114	19-May-98	NW of Co Rd I & Hamline Ave	Shoreview
68	SA8380	COUNTY ROAD B DEMOLITION DUMP	984	22-May-98	vicinity of the NW quad of Rice St & Co	Roseville
69	SA8388	WHITE BEAR LAKE CITY DUMP	1167	4-Aug-98	S of 4th Ave & Whitaker Ave	White Bear Lake
70	SA8442	PIGS EYE LANDFILL	844	4-Aug-98	Near Pigs Eye Lake Road - Approx 240 Blk	St. Paul
71	SA8374	RYAN (NSP & UNIV OF MINN ASH) ASH DUMP	974	19-Aug-98	East side of Highway 49 (Rice St.) near	Little Canada
72	SA8387	WYBIERALA DUMP	1165	22-May-98	near Bibeau Rd & Fischer Lane	White Bear township
73	SA8375	NORTHERN ORDINANCE FOUNDRY SAND	977	18-Aug-98	"Between Payne and Edgerton, So of Allen	Little Canada
74	SA8376	VENBERG ASH SITE	979	21-Aug-98	West Side of Highway 61 near Beam Avenue	Maplewood
75	SA8385	ABANDONED DUMP (St. Paul)	1132	13-Jan-00	near St. Paul Ave & Yorkshire Ave	St. Paul
76	SA8377	CLARENCE LACTORIN DEMOLITION DUMP	980	22-May-98	West side of Highway 61 South of Beam Av	Maplewood
77	SA8384	SHAFER CONSTRUCTION DEMO	1129	27-May-98	NE of Pierce Butler Route & Prior Ave	St. Paul
78	SA8378	MAPLEWOOD MUNICIPAL DUMP	981	22-May-98	"South side of County Road C, 1/8 mile	Maplewood
79	SA8382	MCKNIGHT DEMOLITION	987	22-May-98	"Between Mohawk Rd and Co Rd C, W of	North St. Paul
80	SA8379	LITTLE CANADA MUNICIPAL DUMP	982	22-May-98	Vicinity of Lakeside Court and Keller Pa	Little Canada

DUMP INVENTORY FOR RAMSEY COUNTY, MN.

Site #	Map* Location	City	Description (names, dates, history of site, etc.)
1	D&E-7	Arden Hills	A.J. Heimbach; Arden Hills 1974; lot 4 block 8 Josephine Hills plat; applied for a use permit to fill this area. Oct. 28, 1974- request denied; asked to remove all fill; 12/11/74- part of this fill removed by C.W. Houle to Hilstad site on Hodgson Rd., north of I. Remainder graded and leveled; site closed Ingerson Rd. and Hamline Ave. N.. See also Hilstad site #112.
2	C-6	Arden Hills	Harvey Perry; 3544 New Brighton Rd. (Hudson Ave); Arden Hills 1974; lagoon in pig farm area; misc. scrap metal thrown in lagoon- was supposed to be removed. Now this is Open Space (1988).
3	C-6	Arden Hills	City of Arden Hills; Co. Rd. E2 & Cleveland; illegal Public Dumping; correction prescribed was grading above material over S.W. bank of property and cover with clean fill- 1974; 10/7/74- site inspected, much improved, file closed.
4	C-6	Arden Hills	DeCoster Co.; S.E. corner of Cleveland and E2; litter and dumping on development property- 1974; Correction prescribed: Grade and level- push into ditch to cover vehicles- grade southwesterly to avoid drainage ditch.
5	E-6	Arden Hills	Soo Line right of way; rear of 1273 West Co. Rd. E; misc. litter and debris; south side of tracks; May 28, 1974.
6	E-6	Arden Hills	Rysgaard-Master Co.; mfg. of fiberglass; area behind small sheds, south of Soo Line right of way; unnecessary litter, rat complaint; improvements made 1974.
7	E-5	Arden Hills	Dean Larson of MN. Hwy. Dept., Dist. 9 (3485 Hadley Ave. N., Oakdale, MN 55128); July 1974; numerous large appliances and old car hulks; removal prescribed.
8	C&D-5&6	Arden Hills	Sears; 1/2 mile S. of Co. Rd. E2, between Cleveland and Snelling, just west of Valentine School; cartons dumped by N.E. Sheet Metal 1974.
9	C&D-5&6	Arden Hills	Lindholm, LaMere; S. of Co. Rd. E2, near Valentine School; magazines, newspaper; cleaned up 1974.
10	D-6	Arden Hills	Charles Perry Park; on New Brighton Rd. in Arden Hills; 1974- 2 complaints of littering: Trash, beer cans, magazines; cleaned up.
11	J-12	St. Paul	Ray Anderson & Sons; 930 Duluth St.; 1982; accused of running transfer station without a permit; solid wastes stored in improper fashion; licensed as a transfer station?- not according to file.
12	L-9	No. St. Paul	Anchor Block; 2300 N. McKnight Rd.; 1986; broken concrete block- o.k.; closed in June '86; asphalt mentioned belonged to Schifsky (adjacent site); also note in file describing how Schifsky area should be filled- next to County Open Space and Anchor; Anchor obtained a permit to place concrete pieces on lot 28, Castlewood addition, Ramsey County.
13	J-13	St. Paul	Fish Hatchery; supposedly was a landfill before 1970 (way before); 1971-'72- possibility of new landfill.
14	M-10&11	Maplewood	Maplewood Dump; demo, leachate- 1980; very large former city dump (1950's-1970); most was covered by 1980, but some material, demo and other, was exposed- western 2 acres; leachate observed flowing from exposed debris to drainage ditch which eventually flows to Beaver Lake; dump was flooded.
15	I-6	Vadnais Heights	Minn. Lumber & Wrecking; covers approximately 18 acres; 1/8 mile west of intersection of Co. Rd. E & 35E; 1980; site was not inspected, but site has been closed and developed; not much known about materials disposed of at this site; 1968-197_; another site (#19) was also licensed to Minn. Lumber & Wrecking.
16	K&J-14	St. Paul	Pigs Eye; Approximately 500 acres; 1 Map Location- 1 mile S. of Warner Rd., N. of Pigs Eye Lake; inspected 1980; been closed since 1970; leachate into wetlands and Pigs Eye Lake; also MWCC ash disposal.
17	H-14	St. Paul	State Street; located S. of Plato on State Street; closed in 1950's; "Site now industrial park"- Riverview Industrial Park; possibility of methane gas being produced.
18	C-1	Shoreview	U of M; approximately 10 acres; 1/2 mile east of 35W, 3/4 mile N. of County Rd. I; nature of waste buried here not known.
19	H-5	Vadnais Heights	Vadnais Hts.; approximately 4 acres; 1/2 mile east of County Rd. 57 on County Rd. F; converted to community park; Minn. Lumber & Wrecking also connected with this site; Note: See site #15- Minn. Lumber & Wrecking is mentioned as company terminating this site which makes it sound like this was their landfill. Also the permit for a demo landfill was in their name- 1971; 1974- odor problems.
20	I-4	White Bear Twp.	White Bear Township; north of Hwy. 96, E. of Soo Line R.R.; also known as Krawczewski landfill, 1972 proposal said this has been a dump for 50 years- up to 1986; also called Red Arrow/Haynes. 2009 update: MPCA letter re: methane monitoring as part of Mark of Excellence Homes development (2003). Undeveloped parcel north of Weston Woods Way. Developer buried significant quantities of wood chips and other organic material during construction of homes in 2003. MPCA subsequently installed ten methane monitoring points (MMP's). Some organic material excavated in December 2007, and again in May - June of 2008. Parcel ID # 16-30-22-32-0024.
21	J-13	St. Paul	Johnson Parkway Dump; originally a brick quarry- 70 ft. deep; dumping started in 1920's; closed in 1960's; contained plant debris, demo material, garbage, commercial trash, and tin cans; Present (1989)- Johnson Liquor Store.
22	H-14	St. Paul	Baler Plant; May 1979; Crosby American Properties; Am Hoist- Am Systems High Density Baling Plant; 63 S. Robert; no major problem- some scattered litter; refuse transfer station needs to remove this; also mentioned in Midway Refuse Systems Inc.- 224 Starkey address.

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Site #	Map* Location	City	Description (names, dates, history of site, etc.)
23	B-6	New Brighton	Browning Ferris Industries transfer station; New Brighton; 1021 1st St. N.W. 55112; no major problems; minor litter summer of '79
24	D-11	St. Paul	Burlington Northern; 1979; area adjacent to Pierce Butler Route; dumping by residents; 2nd area a few hundred yds. north of 1st location- approximately 40 acres; demolition, concrete, scrap (described as many thousand tons); also called State Fair Landfill; 1980 MPCA survey states vast amounts of demo waste deposited over 15 years; 1980-appears to be covered & cleaned up.
25	B-6	New Brighton	Silver Lake Rd; 1980; recorded as abandoned dump site; between Sioux Ct. and Tioga Ct.- 1/2 block east of Silver Lake Rd.; New Brighton municipal waste during late 1950's; subdivision now there.
26	E-11	St. Paul	Chemtron; lime sludge storage; over the years there were reports of illegal dumping- white goods etc. (1980) at or near 965 N. Lexington Pkwy.; also called St. Paul Lime Pond.
27	L-13	St. Paul	Clapp-Thompsen Co.; 1977-80; fill area where some debris was also dumped ; S.W. corner of McKnight and I-94.
28	D-13	St. Paul	Chemex; bulk storage of chemical waste; 1976; like a transfer station; 1400 block of Marshall Ave.
29	M-10	Maplewood	Century Disposal; 1971-1978; proposal for transfer station which was never built; in Maplewood; mention is made of the old dumpsite needing work to be terminated properly- "Some refuse still exposed."; 2635 E. Marylake Rd.; probably the same as #14.
30	G-9	Maplewood	Dart Transit; 1980; illegal dumping; Dart Transit wanted to clean up this mess and wrote about a temporary license to do this; Maplewood.
31	H-14	St. Paul	Danny's Recycling and Transfer Station; 359 S. Robert- 1974; 1980-1981 no major problems.
32	I-6	Vadnais Heights	Vadnais Hts.; 1971; possible demo debris dumped; N.E. corner of 35-E and County Rd. E.; owned by Conry Talmage- Vadnais Hts.
33	F-9	St. Paul	Kent and Ryan; 544 Ryan; Robert Smith- owner; asphalt and fill being used to "create" back yard; informed that demo landfill permit needed; site covered-1988; Roseville
34	G-7	Little Canada	Frattalone Demo Landfill; Frank Frattalone- Frattalone Excavating and Grading; 1983-1988; Little Canada.
35	H-5	Vadnais Heights	Gondek Demo Landfill; 1987; goes back to 1980; Richard Gondek
36	J-12	St. Paul	Cemstone Inc.; 1987; 1400 block of Reaney; concrete; illegal dumping; just a small note in file
37	G-11	St. Paul	Frisch Site; 1937 Hawley; 1987; waste materials; instructed to cover and close site and post signs; Hawley Street- street right-of-way never developed.
38	C-3	Mounds View	Mounds View; 1987; 35-W between Co. Rd. I and H; 5/11/87- white goods graveyard; some burial on site of trash as late as 1987; property developed in 1988.
39	I-13	St. Paul	Dump Site at Pierce Oil Property and Radium Petroleum Co.; 275 commercial (next door); Lametti and Sons dumping at Radium Petroleum.
40	C-12	St. Paul	Grief Brothers; 1987; 1821 University; landfilling ash on property.
41	H-10&11	St. Paul	Ralph Alton- Stillwater; 1987; 548 E. Arlington; concrete and other wastes buried on back part of lot.
42	I-12	St. Paul	Payne & Wadena; east of businesses here and south of homes on Wells; small garbage dump; 9/5/86.
43	E-2	Shoreview	Flick Landfill; Kenneth Flick; 1974-'79; seems this was demo landfill (1974; A&A Machine Co.) -licensed 1975, and after not used continuously - Intent to fill in 1979 is indicated.
44	K-7	White Bear Lake	White Bear Lake; 1992; Dumping of tires, chunks of concrete, and scrap metal on the north side of Buerkle Rd. east of Buerkle Circle.
45	J-5	Gem Lake	Gem Lake; 1981; dumping of all sorts of material; Larry Kuehn, Kuehn Excavating, 1381 Goose Lake Rd.; other dumping along Goose Lake Rd. back to 1974.
46	C-16	St. Paul	Johnson Construction; by Ford Plant; 1979-1980; demolition from Lock and Dam #1.
47	J-12	St. Paul	Kamish and Sons; demo landfill; 1979-80; on E. 7th; 2 adjacent land owners- 1518 E. 7th and 1871 E. 7th; 1984- site west of Hazelwood.
48	F-12	St. Paul	Saint Paul; 1998; Former Dale Street Railroad Yard site (BNSF); located at 619 Minnehaha Avenue; 35-acre area bound by West Minnehaha Ave on the south, Arundel St. on the east, Dale St. to the west, and the BNSF mainline railroad tracks to the north. Leaky underground petroleum storage tank; Approx. 500 C.Y. of tar-like/chlorinated solvent contaminated soil removed from the northeastern corner of the site in 1999.
49	I-8	Little Canada	Little Canada; un-permitted lots 5,6,7,and 8 of Blomquist Lakeside Addition; demolition debris and garbage: Paul Sprosty; located between Keller Parkway and Lake Gervais.
50	H-7	Little Canada	Ryan Landscaping; 1980; Little Canada; debris, ash, and demolition; also 3151 Country Drive? (1974).
51	H-9	Little Canada	Little Canada; Ted Huct's: near 35 & Rice; 155 E. Viking; debris from Tony Company and electrical products (1980).
52	H-8	Little Canada	Little Canada; 1980; site adjacent to Lake Gervais; "New homes there now"; runs along Little Canada Creek; uncertain if this is correct location (see also site #49); 4/91- a dump site record/data search revealed no further information pertaining to this site.
53	J-6	Vadnais Heights	Vadnais Heights; 1980 Vadnais Hts.; dumping- asphalt, other items; 3 blocks south of intersection of LaBore and County Rd. E; not sure if "E" was readable on report; this is in Little Canada file because it was noted on memorandum with other sites in Little Canada.
54	G-7	Little Canada	Little Canada; 1980; Riverside Generating Plant; fly ash, cinders, bottom slag at V. Mogren property- southern 1/2 of N.E. 1/4 of Sec. 6, T29N, R22W.

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55	H-8	Little Canada	Little Canada; 1980; illegal dumping; was cleaned up and filled; 2530 McMenemy.
56	H-8	Little Canada	Little Canada; 318 Rose Lane; 1980; William Stewart; dumping oil north of garage on Stenger property.
57	I-9	Little Canada	Little Canada; 731 E. Co. Rd. B2; demolition debris and tree wastes.
58	H-8	Little Canada	Little Canada; 1979; demo debris 2756 & 2776 Edgerton St.; Kenneth Barreau.
59	G-7	Little Canada	Lametti and Sons; 1978; small bypass in front of Spruce St.; while working on a sanitary sewer near wetland area; mostly clean granular material; small amount of asphalt.
60	G-8	Little Canada	Little Canada; 1974; 11 East Little Canada Rd.; abandoned auto, barrels, appliances, furniture.
61	B-4	New Brighton	Long Lake Tar Pit; 1986; old refinery; tar pits discovered when planning for park; eventually cleaned up by County; New Brighton.
62	B-2	Mounds View	Greenfield Estates; trash in drainage ditch in back of Greenfield estates; Greenfield, Co. Rd. I.
63	B-2	Mounds View	Scotland Green Apts., 2662 Scotland Court; Mounds View 1980; near apartment tennis courts- demo waste.
64	I-8	Maplewood	Maplewood; 934 E. Co. Rd. C; 1987; concrete, tires, lumber, tree stumps.
65	L-7	Maplewood	Maplewood; 1980; illegal dumping; solid waste north of Woodlyn Ave.- west of McKnight.
66	J-7	Maplewood	Maplewood; 1981; possible ash disposal site; some illegal dumping in the past; east side of 61, just north of Venberg Tire.
67	J-9	Maplewood	Cope and English; 1980; Maplewood; clean fill and some concrete; C&H contracting- Elk River; OK'd- no potential for pollution.
68	K-9	Maplewood	Maplewood; 1980; illegal dumping; east side of White Bear near Burke; concrete, asphalt, brush.
69	G-10	Maplewood	St. Paul Brass Foundry; 1980; Maplewood near Roselawn and Water Works Road (behind Amusement City); foundry wastes.
70	J-7	Maplewood	Forsley Excavating; along 61, just south of 694; 1979; Maplewood; concrete, asphalt, scrap, tar shingles.
71	H-10	Maplewood	Maplewood; 1979; closure of demo landfill; 528 Kingston; Bauer Bros.; near Soo Line, back of house at this address; some metal, other wastes; 1989-railroad no longer there.
72	L-16	St. Paul	Highwood and Carver, west of McKnight; St. Paul; illegal dumping of tires; 1979.
73	L-10&11	St. Paul	Omaha Rod and Gun Club Road; tires traced to same source as #72; 1979; also boxes of litter and other litter complaints recorded in this area; S. of Larpenteur, N. of Soo Line, along McKnight or described as between Larpenteur and Ivy, along McKnight.
74	G-10	St. Paul	Saint Paul; 2002; 1501 North Jackson St.; uncontrolled filling activities occurred from prior to 1940 to approximately 1980. St. Paul Public Works issued a landfill permit for the site in 1966 but it was rescinded due to poor maintenance of the dump and promiscuous dumping. Fill debris was identified as ranging upwards to 21 feet thick and included a layer of fly ash overlying a sequence of municipal debris consisting of soil intermixed with brick, concrete block, glass, wood, and metal. (Added to list 2/2006)
75	C-11	St. Paul	Minnesota Transfer Railway; disposal of railroad ties and other wastes.
76	I-14	St. Paul	Metro Airport Comm./Holman Field; 1979; 1985- fly ash; old landfill with demo waste.
77	D&E-11	St. Paul	Midway Refuse Systems Inc.; 1974-1978; transfer station; 1301 DeCourcy Drive (now Energy Park Drive) and Hamline.
78	C-5	New Brighton	New Brighton; 1995; Downtown New Brighton Redevelopment Area: City blocks bounded by 5th Ave, 8th St., 6th Ave, and 10th St; Soils with elevated photo-ionization detector (PID) readings for tetrachloroethylene (PERC) were excavated from the site and taken to USPCI for disposal. (Added to list 2/2006)
79	C-5	New Brighton	New Brighton; 2005; Properties in the NW Quadrant at the intersection of I-694 & I-35W including: former Dahlke Trailer Sales, former Lange Properties, the Froelich/Zelickson property (US Post Office), former Grace Haines property, former Mangeloch Company, former Darling International, former Anoka Farm Service Co-Op, a spur of the MN Commercial Railway, and the former Miller Dump. The "Old Miller Dump" is approx. 25 acres in size and contains refuse to a thickness that exceeds 30 feet in some areas. Estimations indicate between 60,000 and 100,000 c.y. of waste in the dump. (Added 2/2006)
80	G-14&15	St. Paul	NSP Island Ash Stockpile; MWCC ash disposal site also of interest- #16 Pigs Eye.
81	C-4	New Brighton	Herbst Demo Landfill; "to be" closed in 1980; dumping still going on in Sept of '80; approximately 15 acres.
82	C-5	Arden Hills	Gordon Rendering; 1980; 2 ponds; grease, oil, cooking fats in pond area.
83	K-5	White Bear Lake	Kohler Mix Specialties; 1980; accepts non-contact cooling water from the manufacturing process; 4041 Hwy 61, White Bear Lake; 2 ponds.
84	B-9	Roseville	Paper, Calmenson and Co.; 2 ponds; wash from paint booth, cooling water; 1980.
85	C-8	Roseville	Williams Bros. Pipeline; 1980; surface impoundments; Roseville.
86	J-13&14	St. Paul	Burlington Northern Inc.; surface impoundments about 1 mile south of Warner Rd.; 1980; erosional problems.
87	C-6	New Brighton	MacGillis & Gibbs/Bell Pole & Lumber; contains 1 pond; surface impoundments; 1980; run off; wood products treatment; 8 wells- 3 of which have shown contamination with pentachlorophenols and arsenic.

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88	D-12	St. Paul	Mowrey & Co.; surface impoundments; 1435 University, between Pascal and Albert; metal refining 1980.
89	G-14	St. Paul	NSP High Bridge Generating Plant; 1980; evidence at this site of prior disposal of bottom ash and demo waste; surface impoundments.
90	H-12	St. Paul	Saint Paul; 2005; Phalen Westminster Crossing Site, 521-563 Phalen Blvd. MPCA VIC staff investigations at this site have detected the presence of diesel range organics (DRO), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), arsenic, mercury, lead, and asbestos in the soil. (Added 2/2006)
91	C-4	New Brighton	Nielsen-Miller; 1986; construction debris; some oil and paint contamination likely; "old Herbst landfill (#81) is located just west of this site"; new At&T facility; also could be some overlap with Chies Dump (#136) closed in 1971.
92	H-12	St. Paul	Saint Paul; 2005; Phalen Westminster Crossing Site, 521-563 Phalen Blvd. MPCA VIC staff investigations at this site have detected the presence of diesel range organics (DRO), volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), arsenic, mercury, lead, and asbestos in the soil. (Added 2/2006)
93	C-6	New Brighton	Illegal Dumping; New Brighton; 1981; demo and other waste; 5th Ave. S.W. and 1st St.
95	B&C-6	New Brighton	John Miller/Old Potters Landfill; foundry sand disposal site and former Old Potters Landfill.
96	B-7	St. Anthony	37th and Chandler; 1979; demo wastes; actually in St. Anthony; owner in New Brighton; "ongoing fill project"; asphalt, concrete.
97	B&C-5	New Brighton	New Brighton; 1992; Dumping of large amounts of soil mixed with garbage, rock, gravel, and wood waste. Located north of Old Highway 8 and east of 8th Ave NW.
98	B-2&3	Mounds View	Mounds View; 1992; Dumping of concrete, asphalt and wood waste on the property south of County Rd H2, north of Louisa Ave and west of Long Lake Rd.
99	M-8	No. St. Paul	Berwald Roofing; waste tar oil; roofing; 2440 N. Charles.
100	M-10	Maplewood	Maplewood; 1992; MnDOT dump site where dirt, asphalt and concrete were piled, 10-20 feet high. Located North of Larpenteur Ave., west of Century Ave, and across from Highway 5.
101	K-9	Maplewood	Anchor Block; waste block being deposited at 1777 E. Hwy 36; Maplewood; 1978.
102	K-16	St. Paul	North Star Steel; sludge stored next to Pigs Eye Lake.
103	H-12	St. Paul	Poor Richards; 1988 and before; transfer station- 400 Whitall; contamination of property with oil and lead (from batteries); known or suspected.
104	H-12	St. Paul	Poor Richards- Westminster Dump; corner of Cayuga and Westminster; property owners- VanWaters and Rogers; foundry wastes, a variety of garbage.
105	H-12	St. Paul	Foundry Waste; prior foundry waste disposal observed across from Poor Richards, north of Whitall, between Arkwright and Western.
106	D-4	Arden Hills	Elmer Cmiel; demo landfill, Arden Hills; 1974; city of Minneapolis Paving Dept. filling with asphalt; old state Hwy 10 and S. of old state Hwy 96.
107	G-13	St. Paul	Saint Paul; Department of Revenue site, includes 2 city blocks bounded by 12th St, 14th St, Jackson St, and Robert St. Approx. 15 c.y. of tar contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and metals were uncovered during excavation activities south of E 13th St. The tar was classified as a characteristic hazardous waste for lead. 15 c.y. of tar-contaminated soil was also uncovered during excavation activities south of E 13th St. This material contained VOCs, SVOCs, and diesel range organics.
108	D&E-2	Shoreview	Shoreview- Votel Site; 1974-1984; north and east of I at Hamline; continuing dumping of old "lumber, plastic, brush, appliances, and much more"; 1980- letters to Lametti Construction and Thorp Financing about dumping in this area.
109	E-2	Shoreview	Willis A. Wilson; 975 W. Co. Rd. I, Shoreview; permit granted for filling property with demo debris; status unknown.
110	L-7	White Bear Lake	Jerome Bergeron; landfill near home- 3191 Karth Road, White Bear Lake; some filling conducted with demo debris apparently.
111	G-10	Maplewood	Percy Fulton; demo landfill at Beaumont, north side of Larpenteur; Maplewood.
112	F-2	Shoreview	Hilestad; application sent for demo landfill west of Hodgson Road, north of Co. Rd. I; some filling with demo debris had apparently occurred.
114	B&C-7&8	Roseville	Roseville; 1980; illegal dumping; east of Long Lake Rd., north of C2; variety of items and garbage.
115	G-9	Roseville	Roseville; N.W. corner of Co. Rd. B and Rice; concrete and other demo waste; future apartment buildings; no year noted.
116	G-10	Roseville	Roseville; site of non-hazardous dumping; 1981; furniture, empty drum, etc.; south of McCarrons Blvd., end of Marion.
117	F-9	Roseville	Roseville; Minnesota Ave. between Dale and Western; 1981; demo waste, dirt, concrete.
118	F-9	Roseville	Roseville; illegal dumping S.E. corner of Highway 36 & Victoria; remodeling debris; 1980.
119	D-7	Roseville	Roseville; illegal dumping; must be removed or covered; near "Paul's Place" (2965 Snelling Ave N.).
120	C-7	Roseville	Roseville; illegal dumping; 1974; discarded scrap metal, lumber, trees; 3010 N. Cleveland; fire calls to this area.
121	C-7	Roseville	Roseville; illegal dumping; 1974; east side of Long Lake Rd., between C2 & D.
122	D-8	Roseville	Roseville; 1974; illegal dumping; appliances, tires, bed springs; 2691 N. Snelling.

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123	B-7	Roseville	Roseville; 1974; east of ponding area, N. of C2, west of Long Lake Rd.; demo & other waste.
124	G-9	Roseville	Roseville; 1974; 202 W. Co. Rd. B; demo fill; site will be closed.
125	B-7	Roseville	Roseville; 1973; 2374 W. Co. Rd. D; concrete and clay; small amount of household dumping.
126	D-8	Roseville	Roseville; 1972; petroleum products into Co. Ditch 4 from Bruce Motor Freight, Inc.; 1743 W. Co. Rd. C
127	B-9	Roseville	Roseville; 1972; debris, concrete, asphalt, other items; Terminal Rd. & St. Croix St.
128	G-9	Maplewood	Maplewood; 1972; appliances, lumber; behind Dean's Liquor, E. side of Rice St., 1/4 mi. S. of Co. Rd. B.
129	G-10	Maplewood	Maplewood; 1972; dumping of wood, metal, cans, etc.; just N. of Rice and Larpenteur- east side.
130	G-7	Little Canada	Little Canada; 1972; east side of Rice, just N. of Soo Line; concrete, demo, lumber; illegal dumping.
131	M-9&10	Maplewood	Maplewood; 1972; open dumping; 2616 Holloway; cans, lumber, metal; on a marsh.
132	L&M-10	Maplewood	Maplewood; 1972; open dumping; not serious; domestic debris; S. of intersection of Ripley & Sterling; 4/91- a dump site record/data search revealed no further information pertaining to this site.
133	L-10	Maplewood	Maplewood: 1972; dumping of construction debris; 2343 Larpenteur; no big problem; being developed; Larpenteur & Sterling.
135	K-14	St. Paul	Point Douglas Road; small amount of dumping; 1981
136	C-3&4	New Brighton	Chies Dump; began in 1963-71; 64 acres; overlaps with Herbst Construction #81
137	H-12	St. Paul	Witt Site; 1984; demo waste; city dump permit 1983; St. Paul; closing 1984- illegal dumping afterwards.
138	D-2	Shoreview	Shoreview; 1983; open dumping just across from Votel Site (#108); various garbage; was supposed to be developed for housing.
139	G-5	Shoreview	Shoreview; 1981; open dumping on property owned by North Oaks Realty; tires, asphalt.
140	D&E-2	Shoreview	C.W. Houle; filling on S. side of Co. Rd. I at Hamline; Shoreview; 1974; earlier (1971) had special use permit.
141	D-1	Shoreview	Shoreview; 1974; W. of Lexington, S. of Co. Rd. J; litter and garbage; both sides of Rice Creek; Flannigan property S. of Rice Creek mentioned- in process of becoming County Open Space; cleanup with Boy Scouts- July 15, 1974; rest left to County O.S..
142	D-2	Shoreview	Shoreview; 1974; refuse, household garbage; dirt road extension of Fairview.
143	E-4	Shoreview	Shoreview; 1974; household litter, magazines, books; was cleaned up; 4/10- a dump site record/data search revealed no further information pertaining to this site.
144	I&J-5	Vadnais Heights	Vadnais Heights; open dumping; 1972; trees, demo waste, appliances; both sides of 35E.
145	E-6	Shoreview	Shoreview; wanted to clean up landfill areas along N.E. corner of Lexington & E.; 1974; 4/91- a dump site record/data search revealed no further information pertaining to this site.
146	E-6	Shoreview	Shoreview; 1974; landfill N.E. of Lexington and Island Lake Avenue; demo waste mostly from Park Construction.
147	E-5	Shoreview	Shoreview; 1976; N. of 694, E. of Lexington; cement truck washings.
148	I-4	White Bear Lake	Schumann Sites; 1985; 4500 Centerville Rd.; demolition debris.
149	I-4	White Bear Lake	Schumann Site; 1985; 1101 S. Birch Lake Blvd.; small dump site including paint wastes; some solvent and fuel oil contamination suspected.
150	C-11&12	St. Paul	Shafer Demolition Landfill; 1978; Prior and Pierce Butler; very large amount of demo debris dumped.
151	H-10	St. Paul	Stone Property Demo Landfill; 1985
152	G-14	St. Paul	Twin City Refuse and Recycling Transfer Station; 1977-1988; 318 Water St.
153	I-12	St. Paul	Bergman Builders; 845 Earl; went out of business about 1980; dump site-possibly some hazardous.
154	F-10	Roseville	Kennard & Case; 1985; filling going on N. of Larpenteur, E. of Kent; brush, tar sealant or similar material.
155	F-15	St. Paul	Lilydale; 1985; multiple sites throughout area; household garbage, brush, shingles, mattresses.
156	F-14	St. Paul	Illegal dumping visible from 321 Colborne; possibly some of this is Highway Department land; 1987.
157	D&E-13	St. Paul	Hamline & I-94 service road; sludge site- possibly heavy oils, tars, inks; apparently used 1955-1962; waste possibly generated by Brown and Bigelow-1981 letter.
158	G-14	St. Paul	Water St. below Cherokee Park; 1980; household garbage, furniture, white goods, tires.
159	G-15	St. Paul	Cherokee Hts. Blvd. and Baker; 1980; household garbage thrown over steep bluff.
160	H-12	St. Paul	St. Paul Street Sweeping Site; 1980-89; Rivoli & Minnehaha; sand, leaves, litter, white goods, household garbage, and tires.
161	K-14	St. Paul	Battle Creek Area; 1979; "more" dumping; 100 yards N. of Battle Creek Park, dirt road W. of 61.
162	H-14	St. Paul	Metals Reduction Company; 141 Water Street; 1980; notice that they should be monitoring their site for hazardous conditions.
163	F-12	St. Paul	St. Paul, just E. of 698 Lafond; 1980; dumping waste oil.
164	G-10	St. Paul	Demo dumping- unpermitted; 1980; 261 W. Arlington; Luske & Sons; wood wastes.
165	H-11	St. Paul	Demo debris dumped near 35E; 1181 Westminster; 1979.

DUMP INVENTORY FOR RAMSEY COUNTY, MN.

Site #	Map* Location	City	Description (names, dates, history of site, etc.)
168	J-12	St. Paul	Birmingham & 7th Street; 1979; dumping of tar paper, asphalt, other scrap; not sure at which corner of intersection this occurred.
169	D-17	St. Paul	Watergate Marina; 1979; demo wastes, concrete scrap, metal, wood debris; seems to have been deposited "several years ago" (written in 1979); "ongoing deposition"; not a problem; 2500 Mississippi River Blvd..
170	J-8	Maplewood	Venberg Tire and Battery Company; 2990 Highway 61 N., Maplewood; 1979; "should remove tires and demo wastes" before proceeding with plans for parking lot.
171	B&C-12	St. Paul	Sewal Gear Mfg.; 705 Raymond; request for info on how hazardous wastes (solvents, paints, oils) are handled; 1974.
172	C-12	St. Paul	Dale Sweet (Mankato); liquid storage site; 810 Hampden; site of collecting waste oil; also a spill; 1/7/77.
173	I-13	St. Paul	Industrial Steel Container; 1978; containers of waste sludge at 293 Commercial Street.
174	G-8	Little Canada	Spannbauer-Pepi Enterprises; demo wastes and rubbish; Little Canada Rd., E. of Market Place Drive.
175	B-12	St. Paul	Rausch Mfg.; 1979; solid wastes behind facility; 750 Pelham.
178	H-14	St. Paul	McPhillips Sweeping Co.; refuse, paper, tar paper, plastics, cardboard drums labeled Ammonium Thioglycolate; 207 W. Water Street.
179	F-10	St. Paul	Elmhurst Cemetery; demo debris used to fill a small pond.
188	G-5	Vadnais Heights	St. Paul Water Dept.; 1973; alleged private waste disposal in Vadnais Heights; exact location not certain but around Vadnais Lake and up towards Sucker Lake is Water Dept. land.
189	G-15	St. Paul	Twin City Brick; 709 Joy; disposing of brick and other debris behind 709 Joy.
190	B-11	St. Paul	Burlington Northern; dumping along Kasota; 1973; asked to have cleaned up in 60 days; Kasota & 280.
199	K-4	White Bear Lake	White Bear Lake Public Works Property; 1884 Whitaker; no problems here, just transfer station and recycling center for Knutson Rubbish; also lime sludge S. of Public Works Building; 1972; area west of Hoffman Road- concern about 5" thick insoluble compound in marsh.
200	J-4	White Bear Lake	White Bear Lake; 1986; 1-2 blocks S. of 96, 1st St. E. of 35E; dumpsite; white goods, general rubbish; corner of White Bear Parkway and Birch Lake Blvd.; 4/91- a dump site record/data search revealed no further information pertaining to this site.
201	I-4	White Bear Lake	Industrial Fiberglass Corp.; 1980; disposal of waste behind this facility; 4470 Centerville Rd.; 4/91- a dump site record/data search revealed no further information pertaining to this site.
202	M-1	White Bear Twp.	White Bear Township 1984; 5955 Portland; storage of asphalt.
203	K-6	White Bear Lake	White Bear Lake; 1980; promiscuous dumping; household refuse and furniture; corner of Willow Ave. and Co. Rd. E; property owned by Anderson-Freitag, but they were in process of bankruptcy at this time and property expected to be up for sale soon (Dec. 12, 1980).
204	K-7	White Bear Lake	White Bear Lake; 1979; dumping of solid waste; several owners; White Bear Ave. & 694, west of K-Mart; demo debris, asphalt, tires, garbage.
205	I-4	White Bear Lake	Furlong Oil; 1979; Hwy. 96 & Centerville Rd.; demo landfill.
206	J&K-3&4	White Bear Lake	Otter Lake Rd. - Birch Lake Blvd.; demofill into a marsh; appears to be runoff water storage; 1974.
207	K-6	White Bear Lake	Kenneth Bacchus Co.; development property near Hwy. 244; Burlington Northern tracks; misc. debris, tires; due west of Willow Lane School; cleaned up- 1974.
208	K-5	White Bear Twp.	Markham Const.; 1974; Otter Lake Rd.; demo landfill west of Otter Lake Rd., N. of Burlington Northern.
209	I-2	White Bear Twp.	White Bear Lake; 1975; Centerville Rd. S. of Anderson Lane; concrete and bituminous dumped; also 1979 fill project near wetlands.
210	I-3	White Bear Twp.	Bergamier Property; 1974; dumping of scrap metal N. of Bergamier property; 1075 N. Birch Lake Blvd.; also scrap metal, furniture, lumber on Dale property, just N. of R.R. tracks.
211	J-4	White Bear Lake	White Bear Lake; 1974; 1245 S. Birch Lake Blvd.; ditch west of property; refrigerators, stoves; before White Bear Parkway was built.
212	L-3	White Bear Lake	Grace Development; demo landfill; 1974; White Bear Lake; E. of 61, N. of Chicago.
213	J-4	White Bear Twp.	Gibson Property; 1974; 4544 Otter Lake Rd.; discarded tires, trees, tree limbs.
214	M-3	White Bear Twp.	White Bear Township 1974; discontinued landfill; N. side of 96, W. side of Park; needs to be graded and covered.
215	J-6	Vadnais Heights	LaBore - South of Co. Rd. E.; White Bear Lake; 1974; landfill not graded and covered.
216	L-1	White Bear Twp.	Benson Airport; White Bear Township 1974; tin cans, scrap metal, tires, misc. dumping.
217	G-6	Vadnais Heights	Vadnais Hts. - Little Canada Site; 1972; Sec.31 T30 R22, SWNE or NWSE; wrecked building; cans, lumber, old outhouse; hill on N. side of Owasso Blvd.- this is N. Owasso Blvd. and is now (1989) called Twin Lake Blvd.; site was cleaned up 7/72.
218	G-12	St. Paul	Wilson Auto Salvage; 1985; 340 Atwater; foundry sand.
219	J-3	White Bear Twp.	Lake Sanitation; White Bear Township; actually recycling station; permit not required; a few complaints about unsightly piles of junk; some demo debris deposited on site; 1201 N. Birch Lake Blvd.; 1982.
220	I-6	Vadnais Heights	J.R. Walker and Sons; demo landfill; Vadnais Hts.; 1983; in wetland area.
221	E-5	Arden Hills	Control Data; 4201 Lexington Ave. N.; construction and demolition (concrete and asphalt) buried on site; closure completed 1993.

DUMP INVENTORY FOR RAMSEY COUNTY, MN.

Site #	Map* Location	City	Description (names, dates, history of site, etc.)
222	H-8	Little Canada	Little Canada; 1988; illegal dumping; back yard of 544 LaBore Rd.; near creek which empties into Lake Gervais.
223	D-3	Arden Hills	Twin City Area Ammunition Plant; Arden Hills; many sites within boundaries of plant; materials dumped include: demolition debris, general rubbish, and hazardous wastes; 4/91 a dump site record/data search revealed no information pertaining to this site.
224	B-6	New Brighton	New Brighton; 1989; 357 S.W. Oakwood Drive; Keith and Sandy Oelschlager; demo fill was discovered in back yard when addition was built; others in neighborhood also found demo fill; concrete, steel rods, wire.
225	C-12	St. Paul	Hauenstein & Burmeister, Inc.; 896 Hersey Street, St. Paul; 1990; illegal dumping around plant's dumpster area and in nearby water runoff catch basin; materials dumped include: white goods, mattresses, tires, brush, barrels, and general refuse.
226	C-3	Mounds View	Mounds View; 1990; illegal dumping of an oily liquid in an open area- SW corner by the County Rd. H & I-35W interchange; site is upgrade of Rice Creek.
227	L-14	St. Paul	St. Paul; 1991; Winthrop St.; ravine bordering Ramsey Co. Dist. 1 (Battle Creek/Highwood) compost site; materials dumped include: appliances, galvanized steel, and other demolition debris.
228	G-9	Maplewood	Maplewood; 1991; immediately south of Co. Rd. B on the NW side of Sandy Lake; site is in a ravine on the east side of "Hideaway Night Club" parking lot; materials dumped include: appliances, demolition debris, car batteries, bundles of newspapers, copying machine, roofing shingles, and roofing tar.
229	J-6	Vadnais Heights	Vadnais Hts.; 191; Hoffman Rd.; open area behind (to the east of) businesses along Hoffman Rd.; site was once a wetland- recently been filled with demolition debris; yard waste, tires, brush, and other non- demo materials also present.
230	C-4&5	Arden Hills	Arden Hills; 1991; 14th St. NE; illegal dumping of household items; couches, tires, etc.; along both sides of road.
231	H-12	St. Paul	St. Paul; 1991; 215 Cayuga St.; illegal dumping of masonry, wood, tires, household waste; on downgrade behind "Quality Plating & Polish."
232	B-11	St. Paul	St. Paul; 1991; 2530/2530 Keota; illegal dumping of lumber, wood waste, brush.
233	H-11	St. Paul	St. Paul; 1991; open area east of intersection of Jenks & Agate, between So Line and Burlington Northern R.R. tracks; illegal dumping of concrete waste, tires, PVC pipe, metal waste, tree stumps, corrugated steel culvert.
234	B-11	St. Paul	St. Paul; 1991; truck trailer parking lot just east of 2400 Kasota; illegal dumping of wood waste, mattress, 55 gal. drum (empty), cardboard.
235	J-12	St. Paul	St Paul; 1991; Budget Towing- 846 Earl St.; area between district 5 compost site and Ray Andederson & Sons truck lot; illegal dumping of demo waste, transite asbestos piping, industrial lubricants, transformers, electrical breaker boxes, fuel storage tanks, automobile tanks, tires, and much more.
236	I-5	Vadnais Heights	Vadnais Hts.; 1991; upgrade of drainage ditch which flows parallel to Stockdale Drive, between Stockdale and Elmwood; illegal dumping of asphalt- 4 ft. x 10 ft. pile.
237	B-11	St. Paul	St. Paul; 1991; dead end cul-de-sac on Hunting Valley Rd.; illegal dumping of street sweepings, roofing material, refuse.
238	B-11&12	St. Paul	St. Paul; 1991; Schnitzer Iron & Metal; 2703 Territorial Rd.; debris remaining from building demolition; site extends into Hennepin Co.
239	G-14	St. Paul	St. Paul; 1992; Progressive Contractors Inc.; Lilydale Park, Water St., across river from NSP Highbridge coal facility; City of St. Paul cave fill project; using demolition debris (mostly concrete) and dirt to fill access points to caves along Cherokee Bluff.
240	J-4	White Bear Twp.	White Bear Township; 1992; Bibeau Dump; wetland located at east dead-end of Bibeau Rd.; closed landfill extending into the wetland; area/size unknown.
241	I-8	Maplewood	Maplewood; 1992; Maplewood Dump; located in low area at the southeast corner of Cypress Street and Co Rd. C; site is now a city park; size and materials dumped here unknown.
242	L-8	No. St. Paul	North Saint Paul; 1992; North Saint Paul City Dump; located between 11th St. & 13th St., 7th Ave. & McKnight Rd.; closed in 1967; is now a water retention area and roadway.
243	E-4	Arden Hills	Arden Hills: Control Data Systems; located North of Victoria, West of Lexington, South of Karth Lake. Mainly concrete. Site was closed in Fall of '93
244	C-9	Roseville	Roseville; 1993; Rosewood Corporate Center; located in northwest corner of Hwys 36 & 35W, just to south of Terminal Rd./Co. Rd. B-2. Several hundred cu. yds. of demolition debris on site.
245	F-14	St. Paul	Saint Paul; 1996; St. Paul Levee Site, located south and east of Shepard Road, west of R.R. tracks that cross the Mississippi, (just up river from old NSP plant) and south of where those tracks cross 400 block of James Ave. Estimated 4 acres of open dumping; demolition, appliances, auto parts, tires, etc. (Added to list 7/96).

DUMP INVENTORY FOR RAMSEY COUNTY, MN.

Site #	Map* Location	City	Description (names, dates, history of site, etc.)
246	E-7	Roseville	Roseville; 1996; Ramsey County Open Space; 3076 Lexington Avenue North, (Lake Josephine Apartments). Demolition debris partially buried along north edge of wetland. Many fluorescent lamp fixtures that were visible from the surface were removed during a community clean-up in 1995. (Added to list 7/96).
247	M-2	White Bear Twp.	White Bear Township; 1992; Dumping of domestic debris and tree wastes on vacant property on the west side of Portland Ave across from Paul's Place (Added to list 2/2006)
248	L-12	St. Paul	Saint Paul; 1992; Dumping of concrete and scrap metal in the northwestern quadrant of the intersection of McKnight Rd and Bush Ave.
249	C-5	Arden Hills	Arden Hills; 1992; Brush dumping on the south side of 14th St. NE and east of Round Lake Blvd.
250	M-14	Maplewood	Maplewood; 1992; Dumping of wood planks, scrap metal, and garbage at the Ramsey County Workhouse at 297 Century Ave South.
251	F-12	St. Paul	Maxson Steel Demolition Project; 1998; 551 Topping St. This demolition project involved abatement of friable asbestos roofing and lead paint chips. There was a concern regarding some asbestos material on the ground and lead paint that no longer adhered to a building component.
252	C-4	New Brighton	New Brighton; Trio Solvent Site; U.S. EPA identified the Trio Solvent Site as a potential source of ground water contamination in 1982. A solvent recycling facility was operated on the site between 1971 and 1978. Volatile organic compounds (VOCs) were detected in samples from monitoring and supply wells on the site. In 1986, approximately 3000 cubic yards of contaminated soil were excavated and treated. A pump and treat system operated from 1991 to 1996. Current status: A two-year pilot study, completed in 1999, demonstrated that natural attenuation (NA) is a viable remedy at the site. Implementation of the NA remedy will follow the completion of a Record of Decision amendment. (See "dead zone" file)
253	D-11	St. Paul	Saint Paul; 1982; Koppers Coke is located on a 38-acre site between Snelling and Lexington Avenues and what is now Energy Park Dr. The company operated a coking facility on the site from 1917-1979, producing foundry coke and other by-products that were dumped or spilled on the property. The company completed cleanup of the site in 1998, however, long term ground water monitoring continues to verify that the ground water contamination plume is stable. (Added to list 2/2006)
254	G-14	St. Paul	Saint Paul; 345 Shepherd Rd; H.S. Kaplan Scrap Iron and Metal Company processed scrap metal at this site until closure in 1988. An Environmental Assessment of the Site indicates soil contamination with lead and polychlorinated biphenyls (PCB) at various locations.
255	C-11	St. Paul	Saint Paul; 1992; Dumping of fill piles and scrap metal on the south side of Energy Park Dr. on a diagonal sight line southwest of the municipal stadium.
256	F-11	St. Paul	Saint Paul; 1992; Ecolotech; Heavy metals soil contamination in the northwest quadrant of the intersection of Front Ave and Jameson St. This site was remediated and removed from the State of MN Superfund List in 1998. (Added to list 3/2006)
257	K-11	St. Paul	Saint Paul; 1611 Case Ave; Soil testing at this site reveals DRO contamination from the presence of asphalt and some petroleum contamination.
258	G-13	St. Paul	Saint Paul Arena Project; Demolition of the St. Paul Civic Arena bounded by West 5th St., Roy Wilkins Auditorium and River Centre Convention Center, Kellogg Blvd, and W. 7th St.; The site's subsurface soil contains localized areas of suspected contamination from VOCs from past solvent or petroleum releases at or near the site.
259	B-12	St. Paul	Saint Paul; 737 Pelham Blvd.; Soil analysis in 2005 did not detect contamination. Geoprobe samples for ground water contained chlorinated-VOCs at or below the MDH's health risk limits for drinking water.
260	D-13	St. Paul	Saint Paul; Snelling and I-94 Site Remediation Project for Metro Transit Garage. Plans included floor slab and concrete removal, crushing, placement on site and compaction.
261	I&J-11	St. Paul	Phalen Corridor – Site map of Phalen Corridor Project
262	H-8	Little Canada	Gervais Mill Pond project, one block North of Little Canada Road, west of Edgerton, Little Canada. Burial of tree stumps approved by MPCA in 1993. (added 1/2007)
263	B-2	Mounds View	Mounds View, 1992. Vacant lot across Co. Rd. H-2 from Scotland Green Apts. Two large piles (concrete and asphalt), along with brush.
264	E-11	St. Paul	Minnehaha Avenue & Milton Street Dump. 887 - 893 Pierce Butler Route. According to MPCA, site had been used as a dump for ash and debris. Soil and groundwater contamination is documented. Phase II investigation sampling in November 2006.

* Map location is approximate, and reflects x-y coordinates based on Map of Ramsey County published by Ramsey County Public Works, 1991.

Appendix C
Land Use in Ramsey County

Appendix C (Source: Metropolitan Council)

Land Use In Ramsey County

CITY	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC-RECREATIONAL	HIGHWAYS	SURFACE WATER	NON-URBANIZED LAND (wetlands/undevel./farmland)	TOTAL ACREAGE
Arden Hills	1970	792	54	1,174	587	334	510	2,687	6,138
	1984	1,219	82	1,243	817	334	510	1,933	6,138
	2005	1,318	234	1,094	796	395	626	1,691	6,154
Blaine	1970	0	0	0	87	0	0	0	120
	1984	0	0	0	87	0	0	0	120
	2005	0	9	85	4	3	0	19	120
Falcon Heights	1970	393	42	1	589	13	0	392	1,430
	1984	398	38	5	591	13	0	385	1,430
	2005	440	34	0	661	2	0	296	1,433
Gem Lake	1970	133	36	19	57	8	33	448	734
	1984	160	40	19	57	8	33	417	734
	2005	246	47	0	61	13	37	302	707
Lauderdale	1970	149	9	42	17	8	0	46	271
	1984	160	9	42	17	8	0	35	271
	2005	154	12	33	37	22	1	11	269

Appendix C (Source: Metropolitan Council)

Land Use In Ramsey County

CITY	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC-RECREATIONAL	HIGHWAYS	SURFACE WATER	NON-URBANIZED LAND (wetlands/undevel./farmland)	TOTAL ACREAGE
Little Canada	1970	800	96	22	171	222	320	1,222	2,853
	1984	990	181	53	178	222	320	909	2,853
	2005	1,181	235	216	259	266	328	384	2,869
Maplewood	1970	3,216	277	283	1,288	298	410	5,782	11,554
	1984	3,716	530	401	1,663	317	410	4,517	11,554
	2005	4,958	790	529	2,813	456	458	1,559	11,563
Mounds View	1970	1,231	32	12	185	165	22	1,026	2,673
	1984	1,544	53	47	230	165	22	612	2,673
	2005	1,616	103	157	359	190	25	164	2,632
New Brighton	1970	1,828	63	364	714	204	332	1,031	4,536
	1984	2,102	107	429	716	204	332	647	4,536
	2005	2,298	176	569	820	202	334	131	4,529

Appendix C (Source: Metropolitan Council)

Land Use In Ramsey County

CITY	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC-RECREATIONAL	HIGHWAYS	SURFACE WATER	NON-URBANIZED LAND (wetlands/undevel./farmland)	TOTAL ACREAGE
North Oaks	1970	1,252	5	0	338	0	932	3,212	5,739
	1984	1,647	7	0	371	0	932	2,782	5,739
	2005	2,277	26	4	1,420	0	939	884	5,510
North St. Paul	1970	989	46	61	137	34	79	517	1,863
	1984	1,128	96	68	163	34	79	295	1,863
	2005	1,249	98	92	289	40	95	64	1,927
Roseville	1970	3,789	462	858	753	391	437	2,161	8,851
	1984	4,135	537	1,002	1,377	391	437	972	8,851
	2005	4,229	831	938	1,613	485	451	306	8,853
St. Anthony	1970	111	70	28	5	0	78	136	428
	1984	149	71	32	6	0	74	96	428
	2005	157	67	19	84	0	69	31	427
St. Paul	1970	16,632	1,626	4,574	6,791	951	2,418	2,923	35,915
	1984	16,843	1,697	4,631	6,930	951	2,418	2,445	35,915
	2005	16,563	2,283	4,143	7,613	1,391	2,356	1,548	35,826

Appendix C (Source: Metropolitan Council)

Land Use In Ramsey County

CITY	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC-RECREATIONAL	HIGHWAYS	SURFACE WATER	NON-URBANIZED LAND (wetlands/undevel./farmland)	TOTAL ACREAGE
Shoreview	1970	2,042	30	33	706	127	1,006	4,457	8,401
	1984	2,898	74	150	1,583	127	1,006	2,560	8,401
	2005	3,697	339	182	2,013	138	1,161	572	8,102
Spring Lake Park	1970	28	2	0	1	1	0	0	32
	1984	28	2	0	1	1	0	0	32
	2005	29	1	0	3	4	0	0	36
Vadnais Heights	1970	773	21	33	622	269	698	2,835	5,251
	1984	1,177	80	73	683	269	698	2,261	5,251
	2005	1,781	308	170	953	289	727	1,026	5,254
White Bear Lake	1970	2,636	164	51	722	217	1,454	2,233	7,477
	1984	2,977	202	83	756	217	1,454	1,788	7,477
	2005	3,018	414	156	814	167	356	504	5,429
White Bear Twnshp	1970	728	0	106	430	108	1,028	2,181	4,581
	1984	954	19	116	722	108	1,028	1,613	4,581

Appendix C (Source: Metropolitan Council)

Land Use In Ramsey County

CITY	YEAR	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC-RECREATIONAL	HIGHWAYS	SURFACE WATER	NON-URBANIZED LAND (wetlands/undevel./farmland)	TOTAL ACREAGE
	2005	1,999	85	259	1,534	150	2,285	719	7,031
Total Acreage	1970	37,523	3,033	7,661	14,186	3,350	9,761	33,297	108,812
	1984	42,214	3,823	8,393	16,942	3,372	9,753	24,272	108,812
	2005	47,210	6,092	8,646	22,146	4,213	10,248	10,211	108,671
Acreage Change									
1970-2005		9,687	3,059	985	7,960	863	487	-23,086	

Appendix D

Physical Geography

Appendix D:
Physical Geography

CLIMATE

Ramsey County is located within a sub-humid climate pattern. Winters tend to be very long and cold; summers are short and fairly warm. For the period from 1971-2000, average yearly precipitation amounts for the months of April through October were nearly 21 inches, and an average of approximately 52 inches of snow fell yearly from November to March (Figure D-1). Rainfall patterns vary significantly over short distances; snowfall patterns tend to be more evenly distributed.

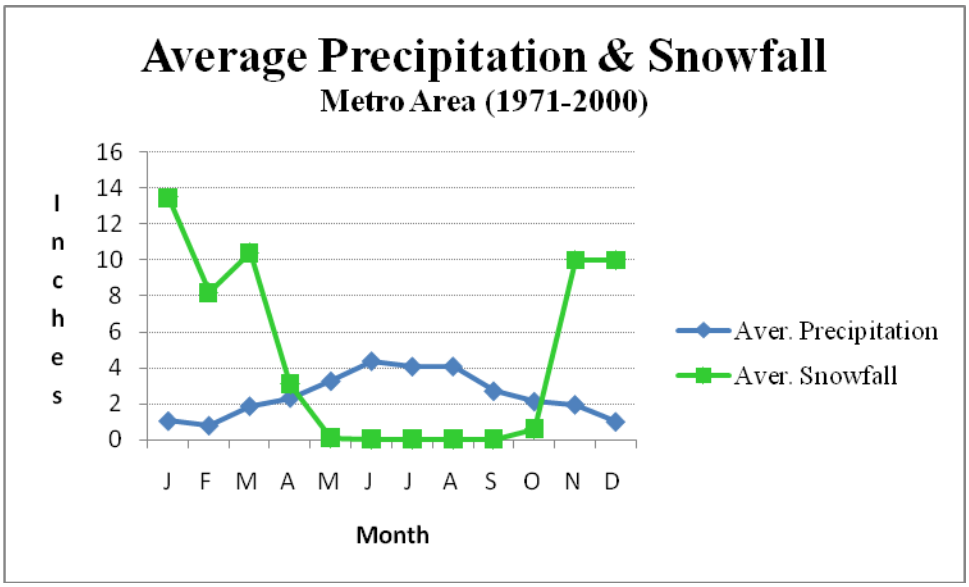


Figure D-1. Precipitation and snowfall. (Source Metropolitan Council)

Precipitation either: evaporates from surface water bodies, is returned to the atmosphere through plant and soil transpiration, or recharges groundwater. Rainfall peaks in the summer at the same time when evapotranspiration rates are highest. The cooler fall months are the most conducive to recharge soils and groundwater since evapotranspiration and vegetative water demands decrease. However, precipitation amounts decline during this season reducing the amount of water available for recharge.

TOPOGRAPHY, RELIEF, AND DRAINAGE

The present topography of Ramsey County is primarily due to the surface of the underlying bedrock topography and the glacial processes and materials they deposited. Post-glacial soil formation and erosion processes have also shaped the topography. Urban development has further modified the landscape on a local scale.

Flat topographic areas occur on glacial outwash plains, on present day flood plains along the

Mississippi River, on terraces representing former stream locations, and in areas where stream channels and other depressions have been filled. Hummocky terrain predominates where deposits of glacial till are located. Steep regions tend to occur along the valley walls of rivers and streams.

Approximately 14 square miles of the county's 170 square mile area is formed by surface water bodies (lakes, streams, wetlands). The drainage pattern in Ramsey County is distinctive. Despite the proximity of the deep Mississippi River Valley, only Rice Creek drains into this major waterway. In other parts of the county, drainage is into the subsurface or nearby lakes, wetlands and other shallow depressions. Urban development has led to extensive wetland habitat loss and the beneficial stormwater treatment they provided. The Minnesota Wetland Conservation Act helps to prevent the further loss of our wetland area resources.

SOILS

The *Soil Survey of Washington and Ramsey Counties* provides a comprehensive assessment of soils and soil complexes. Many soils have been altered through urbanization and associated development practices. Soils are primarily formed from glacial deposits; however, in some areas bedrock surfaces have also shown soil formation. There are five basic types of soil deposits within Ramsey County that are classified according to their parent material (glacial till, glacial outwash, glacial lake sediments, loamy sediments above bedrock, and recent alluvium). Percentages of sand, silt and clay particles determine the texture and drainage pattern of a soil. High water levels depend upon the infiltration and saturation properties of the soil deposits.

The different soil types in Ramsey County are due to the variety of glacial materials from which they originate. In general, coarse and moderately coarse textured soils generally form in outwash and recent alluvial deposits. Medium textured soils tend to form in lacustrine sediments (formed by lakes) and loamy bedrock deposits. Moderately coarse textured deposits form in glacial till areas. Fine and very fine textured deposits are uncommon in Ramsey County. The mechanical properties of soils in Ramsey County are quite important, for they indicate soil suitably for certain forms of development. Classification systems for describing soil properties are provided in detail by the Soil Survey.

GEOLOGY AND HYDROGEOLOGY

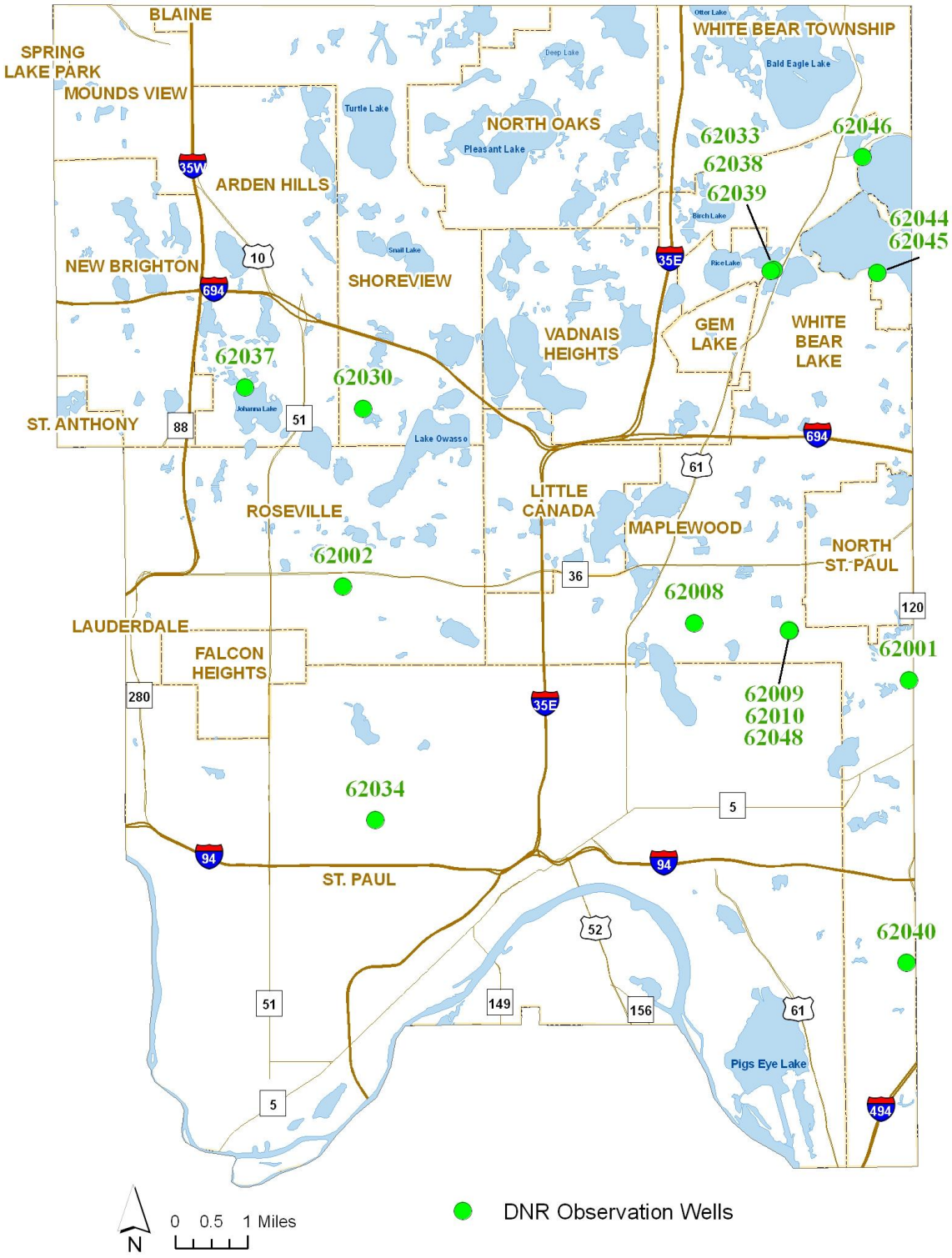
Geologic and hydrogeologic conditions are responsible for the existence of the lakes, streams, and aquifers that we enjoy and depend on here in Ramsey County. An understanding of these conditions is essential to inform decisions that are made that impact groundwater. The Ramsey County Geologic Atlas is the most current and comprehensive assessment of the geologic and hydrogeologic characteristics of Ramsey County. The Ramsey Conservation District made major contributions to that Atlas.

The geology of Ramsey County can be subdivided into two basic classifications, unconsolidated

glacial sediments and consolidated bedrock formations. These deposits also form a sequence of aquifers and confining layers that comprise the hydrogeologic setting of Ramsey County. An aquifer is a geologic formation that is capable of supplying sufficient quantities of water to a well. A confining layer is a geologic deposit like a clay or shale that does not provide water to wells and prevents the flow of water between aquifers. **Readers are encouraged to examine the Ramsey County Geologic Atlas (RCGA) for a full description of geologic and hydrogeologic features and maps.**

Appendix E

Department of Natural Resources - Observation Wells


BLAINE
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MOUNDS VIEW
ARDEN HILLS
NEW BRIGHTON
SHOREVIEW
NORTH OAKS
WHITE BEAR TOWNSHIP
VADNAIS HEIGHTS
GEM LAKE
WHITE BEAR LAKE
ST. ANTHONY
ROSEVILLE
LITTLE CANADA
MAPLEWOOD
NORTH ST. PAUL
LAUDERDALE
FALCON HEIGHTS
ST. PAUL
Turtle Lake
Deep Lake
Otter Lake
Bald Eagle Lake
Pleasant Lake
Snail Lake
Birch Lake
Pike Lake
Johanna Lake
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62008
62001
62009
62010
62048
62034
62040
35W
35E
694
10
88
51
61
36
120
280
5
94
52
149
156
494
0 0.5 1 Miles
N
DNR Observation Wells

DNR Observation Wells
Ramsey County

	Well Nest?	Name	DNR ID No.	MDH ID No.	Depth	Grnd. Elev. (ft)	Stick-up (ft)	Aquifer	Actively Pumped?	Notes
1		NSP Maplewood Gas Plant	62001	200874	523	997.01	2.4	Jordan	Y	20" casing to 91'
2		Lexington Court Apts.	62002	200105	325	946.64	1.4	St. Peter		10" casing to 146', 6" to 192"
3		Maplewood Bowl	62008	244345	163	900	1	Quat. Buried Artesian Aquifer		4" to 158'
4	Nest	Goodrich Golf Crs.-Ramsey Co. #22	62009	200443	523	967.86	2.58	Prairie du Chien-Jordan	Y	12" to 103', 10" to 211'
5		Goodrich Golf Crs. #1	62010	244346	80	970.81	1.3	Till	Y	2" to 78'
6		Goodrich Golf Crs. #2	62048	623058	49	970.71	1.53	Quat. Water Table Aquifer	Y	Replaced DNR well #62011, 2" to 44'
7	Nest	White Bear Twp. Well-Mid	62033	244359	96	928.7	1	Quat. Buried Artesian Aquifer		Near Town Hall, 4" to 91'
8		White Bear Twp. Well-Deep	62038	481807	226	928.36	2.35	Prairie du Chien-Jordan		8" to 35', 4" to 206'
9		White Bear Twp. Well-Shallow	62039	227977	46	929.18	2.55	Quat. Water Table Aquifer		2" to 43'
10		City of Shoreview #1	62030	206833	536	964.94	1.15	Jordan		20" to 129, 12 to 465'
11		City of St. Paul	62034	244360	234	888	2.19	St. Peter		16" to 174'
12		Lake Johanna #19	62037	225652	403	884.43	2.92	Prairie du Chien-Jordan		16" to 200'
13		Ramsey Co. Workhouse	62040	200054	558	1045.41	1.4	Jordan		12" to 491'/obstruction when meas. Level
14	Nest	DNR-Belaire-Deep	62044	551564	195.5	930.15	2.58	Prairie du Chien Quat. Buried Artesian Aquifer		4" to 178'
15		DNR-BelAire-Shallow	62045	551575	31	930.04	2.53			2" to 27.7'
16		White Bear Lake #3	62046	225647	827	926.23	4.2	Prairie du Chien-Mt. Simon		20" csg to 173'

Fro more info. go to:
Ground Water Level Data Retrieval
DNR Waters

Retrieve all observations for a chosen observation well number.

http://climate.umn.edu/ground_water_level/

#1

NSP Maplewood Gas Plant

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Minnesota Unique Well No.
200874

County Ramsey
Quad Lake Elmo
Quad ID 102B

Entry Date 08/14/1991
Update Date 01/09/2004
Received Date

Well Name NORTHERN STATES POWER

Township	Range	Dir	Section	Subsections	Elevation
29	22	W	24	ADAAC	995 ft.

Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
523 ft.	523 ft.	11/29/1957

Drilling Method Cable Tool

Drilling Fluid –

Well Hydrofractured? ☐ Yes ☐ No From Ft. to Ft.

Use Commercial

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
20 in. to 91 ft.	lbs./ft.	

Well Address
1550 CENTURY AV
MAPLEWOOD MN

Open Hole from ft. to ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Geological Material	Color	Hardness	From	To
SAND AND GRAVEL			0	15
CLAY AND ROCKS			15	80
MUDDY SAND AND GRAVEL			80	91
PLATTEVILLE LIMEROCK			91	113
ST PETER SANDROCK			113	275
SHAKOPEE LIMEROCK			275	405
JORDAN SANDROCK			405	488
ST LAWRENCE SHALE			488	523

Static Water Level
142 ft. from Land surface Date Measured 11/29/1957

PUMPING LEVEL (below land surface)
189 ft. after hrs. pumping 510 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
M.G.S. NO. 581.

Grouting Information Well Grouted? ☐ Yes ☐ No

Located United States Geological Survey

Method Digitized - scale 1:24,000 or larger (Digitizing Table)

Unique Number Verification N/A

Date N/A

System *UTM - Nad83, Zone15, Meters*

X: 501140 **Y:** 4981629

Nearest Known Source of Contamination
_feet _direction _type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Cuttings Yes
First Bedrock Platteville
Last Strat St.Lawrence

Aquifer Jordan
Depth to Bedrock 91 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Bergerson-Caswell	27058	

#2 Lexington Ct. Apts

Minnesota Unique Well No.
200105

County Ramsey
Quad New Brighton
Quad ID 119C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 01/07/2004
Received Date

Well Name SPETZ AND BERG

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
29	23	W	11	CCCB	945 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
325 ft.	325 ft.	09/14/1961

Drilling Method Cable Tool

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Well Address
2206 LEXINGTON AV N
ROSEVILLE MN

Casing Diameter	Weight	Hole Diameter
10 in. to 146 ft.	lbs./ft.	
6 in. to 192 ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Geological Material	Color	Hardness	From	To
SAND AND GRAVEL	BROWN		0	53
CLAYEY SAND	BROWN		53	63
SAND AND ROCKS			63	72
CLAY	GRAY		72	82
SAND	BROWN		82	109
SAND AND COARSE GRAVEL	GRAY		109	146
CEMENTED SAND AND GRAVEL PIECES L			146	158
PLATTEVILLE LIMEROCK			158	173
SHALE GLENWOOD	GREEN		173	177
ST PETER	WHITE		177	242
ST PETER SHALESTREAKS	YELLOW		242	252
ST PETER SHALE STREAKS	WHT/BLU		252	275
ST PETER SHALIER			275	281
SHALE	GRAY		281	290
ST PETER COARSE	GRAY		290	325

Static Water Level
108 ft. from Land surface Date Measured 09/14/1961

PUMPING LEVEL (below land surface)
128 ft. after hrs. pumping 200 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
CASING: 010 TO 0146;006 TO 0192.
OPEN HOLE

Grouting Information Well Grouted? ☐ Yes ☐ No

Located United States Geological Survey
Method Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number Verification N/A
Date N/A
System *UTM - Nad83, Zone15, Meters*
X: 488499 **Y:** 4983822

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification
Aamot Well Co. 27062
License Business Name Lic. Or Reg. No. Name of Driller

First Bedrock Platteville
Last Strat St.Peter
Aquifer St.Peter
Depth to Bedrock 158 ft.

#3 Maplewood Bowl

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Minnesota Unique Well No.
244345

County Ramsey
Quad White Bear Lake West
Quad ID 119D

Entry Date 01/16/1992
Update Date 03/13/1992
Received Date

Well Name MAPLEWOOD BOWL
Township Range Dir Section Subsections Elevation 900 **ft.**

29	22	W	16	ADD

Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
163 **ft.**	163 **ft.**	09/01/1961

Drilling Method –

Drilling Fluid –

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Unknown

Casing Type **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 1 **ft.**

Casing Diameter	Weight	Hole Diameter
4 in. to 158 ft.	lbs./ft.	

Open Hole from ft. to ft.
Screen YES **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between
2	18	5	158 ft. and 163 ft.

Geological Material	Color	Hardness	From	To

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
0 ft. after hrs. pumping 3 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
DNR OBWELL 62008

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed
Manufacturer's name STARITE Model number __ HP 1 Volts
Length of drop Pipe 95 ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

Zuercher Well Co.	62028	KIELHABER, J.
License Business Name	Lic. Or Reg. No.	Name of Driller

First Bedrock
Last Strat
Aquifer Quat. Buried Artes. Aquifer
Depth to Bedrock ft.

#4 Ramsey Co. #22 Goodrich Golf Course

Minnesota Unique Well No.
200443

County Ramsey
Quad St Paul East
Quad ID 103A

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 01/14/2004
Received Date

Well Name RAMSEY CO GOLF COURSE NU

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
29	22	W	14	CABCAC	970 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
520 ft.	520 ft.	02/00/1957

Drilling Method Cable Tool

Drilling Fluid –

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Public Supply/non-community **PWS ID** **Source**

Casing Type **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Well Address

MAPLEWOOD MN

Casing Diameter	Weight	Hole Diameter
12 in. to 103 ft.	lbs./ft.	
10 in. to 211 ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen **Make** **Type**

Diameter **Slot/Gauze** **Length** **Set Between**

Geological Material	Color	Hardness	From	To
SAND, CLAY, GRAVEL			0	57
CLAY			57	73
SAND			73	81
SAND, CLAY			81	99
PLATTVILLE			99	130
SOAPSTONE			130	134
ST PETER			134	290
SHAKOPEE			290	422
JORDAN			422	520

Static Water Level
127 ft. from Land surface Date Measured 02/00/1957

PUMPING LEVEL (below land surface)
144 ft. after hrs. pumping 825 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
CASING: 012 TO 0103;010 TO 0211.

Grouting Information Well Grouted? ☐ Yes ☐ No

Located United States Geological Survey
Method Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number Verification N/A
Date N/A
System *UTM - Nad83, Zone15, Meters*
X: 498452 **Y:** 4982734

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

Keys Well Co.	62012	
License Business Name	Lic. Or Reg. No.	Name of Driller

First Bedrock Platteville
Last Strat Jordan
Aquifer Multiple
Depth to Bedrock 99 ft.

#5 Goodrich Golf Crs #1

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Minnesota Unique Well No.
244346

County Ramsey
Quad St Paul East
Quad ID 103A

Entry Date 01/16/1992
Update Date 03/13/1992
Received Date

Well Name GOODRICH GOLF COURSE #1

Township	Range	Dir	Section	Subsections	Elevation
29	22	W	14	CAB	980 ft.

Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
87 ft.	81 ft.	10/20/1966

Drilling Method Auger (non-specified)

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Unknown

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 1.3 ft.

Casing Diameter	Weight	Hole Diameter
2 in. to 78 ft.	lbs./ft.	

Open Hole from ft. to ft.
Screen YES **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between
0		2	78 ft. and 81 ft.

Well Address
ST. PAUL RD W
MAPLEWOOD MN

Geological Material **Color** **Hardness** **From** **To**

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
DNR OBWELL 62010. IN WELL HOUSE BEHIND ALDRICH ARENA

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
_feet _direction _type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

First Bedrock
Last Strat
Aquifer
Depth to Bedrock ft.

License Business Name Lic. Or Reg. No. Name of Driller

#6 Goodrich Golf Crs. #2

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Minnesota Unique Well No. **623058**

County Ramsey
Quad
Quad ID

Entry Date 06/27/2000
Update Date 03/11/2005
Received Date

Well Name RAMSEY COUNTY, GOODRICH

Township	Range	Dir	Section	Subsections	Elevation	ft.
29	22	W	14	CAB	Elevation Method	

Well Depth	Depth Completed	Date Well Completed
49 ft.	49 ft.	01/13/2000

Drilling Method Auger (non-specified)

Drilling Fluid –

Well Hydrofractured? ☐ Yes ☐ No From Ft. to Ft.

Use Monitor well

Casing Type Plastic **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** ft.

Casing Diameter	Weight	Hole Diameter
2 in. to 44 ft.	lbs./ft.	7 in. to 49 ft.

Well Address
1820 VAN DYKE
MAPLEWOOD MN

Open Hole from ft. to ft.

Screen YES **Make** **Type** plastic

Diameter	Slot/Gauze	Length	Set Between
2	10	5	44 ft. and 49 ft.

Geological Material	Color	Hardness	From	To
SANDY CLAY	TAN	MEDIUM	0	40
SAND	BROWN	SOFT	40	49

Static Water Level
37 ft. from Land surface Date Measured 01/13/2000

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
DNR OBWELL 62048
LIC. OR REG. NO. M-0058

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Other from 0 to 5 ft. 1.5 bags
Grout Material: Other from 5 to 38 ft. 2 bags

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP _ Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☑ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☑ No

Well Contractor Certification

First Bedrock
Last Strat
Aquifer
Depth to Bedrock ft.

License Business Name | Lic. Or Reg. No. | LILJEGREN, M. Name of Driller

#7 White Bear Twp Well - Mid.

Minnesota Unique Well No.
244359

County Ramsey
Quad White Bear Lake West
Quad ID 119D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 01/16/1992
Update Date 03/16/2005
Received Date

Well Name WHITE BEAR TOWN HALL

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
30	22	W	23	CBBC	938 ft.	Calc from DEM (USGS 7.5 min or equiv.)

Well Depth	Depth Completed	Date Well Completed
96 ft.	96 ft.	07/16/1974

Drilling Method --

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Public Supply/non-comm.-transient **PWS ID** 5620838 **Source** S01

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?**
☐ Yes ☐ No **Above/Below** 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 91 ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen YES **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between
4		5	91 ft. and 96 ft.

Geological Material	Color	Hardness	From	To

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
DNR OBWELL 62033

Grouting Information Well Grouted? ☐ Yes ☐ No

Located United States Geological Survey **Method** GPS SA Off (averaged)
Unique Number Verification N/A **Date** 03/15/2005
System *UTM - Nad83, Zone15, Meters* **X:** 498072 **Y:** 4990793

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed 07/16/1974
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Submersible Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

First Bedrock
Last Strat
Aquifer Quat. Buried Artes. Aquifer
Depth to Bedrock ft.

License Business Name | Lic. Or Reg. No. | Name of Driller

#8 White Bear Twp. Well - Deep

Minnesota Unique Well No.
481807

County Ramsey
Quad White Bear Lake West
Quad ID 119D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 06/10/1993
Update Date 01/18/2005
Received Date

Well Name WHITE BEAR TOWNSHIP

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
30	22	W	23	CCB	938 ft.	Calc from DEM (USGS 7.5 min or equiv.)

Well Depth	Depth Completed	Date Well Completed
226 ft.	226 ft.	07/20/1992

Drilling Method Non-specified Rotary

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Piezometer

Casing Type Steel (black or low carbon) **Joint** Welded **Drive Shoe?** ☑ Yes ☐ No **Above/Below** ft.

Casing Diameter	Weight	Hole Diameter
8 in. to 35 ft.	28.55 lbs./ft.	8 in. to 206 ft.
4 in. to 206 ft.	10.79 lbs./ft.	4 in. to 226 ft.

Open Hole from 206 ft. to 226 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
28 ft. from Land surface Date Measured 07/20/1992

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Address
4151 HOFFMAN RD
MN

Geological Material	Color	Hardness	From	To
SAND	BROWN	SOFT	0	23
SANDY CLAY	GRAY	SOFT	23	30
CLAY	GRAY	MEDIUM	30	40
GRAVEL	GRAY	SOFT	40	42
SILTY SAND/ CLAY	GRAY	MEDIUM	42	90
SAND	VARIED	SOFT	90	94
CLAY	GRAY	MEDIUM	94	95
SANDW/ GRAVEL	VARIED	SOFT	95	196
BUFF DOLOMITE / SHALE		HARD	196	215
BUFF DOLOMITE		HARD	215	225
SANDSTONE	GRAY	MEDIUM	225	226

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
M.G.S. NO. 3324.
GAMMA LOGGED 7/17/92.

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Neat Cement from 0 to 206 ft. 2 yrds.

Located Minnesota Geological Survey
Method Digitization (Screen) - Map (1:24,000)
Unique Number Verification N/A
Date N/A
System *UTM - Nad83, Zone15, Meters*
X: 498134 **Y:** 4990813

Nearest Known Source of Contamination
400 feet E direction Septic tank/drain field type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number HP Volts
Length of drop Pipe ft. Capacity g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Cuttings Yes **Borehole Geophysics** Yes
First Bedrock
Last Strat
Aquifer
Depth to Bedrock ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Bergerson-Caswell	27058	HOLMEN, G.

#9 White Bear Twp. Well - Shallow

Minnesota Unique Well No.
227977

County Ramsey
Quad White Bear Lake West
Quad ID 119D

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 12/09/1993
Update Date 12/09/1993
Received Date

Well Name WHITE BEAR TOWNSHIP

Township	Range	Dir	Section	Subsections	Elevation
30	22	W	23	CBBADB	925 ft.

Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
48 ft.	46 ft.	04/18/1990

Drilling Method Power Auger

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Monitor well

Casing Type Galvanized **Joint** Threaded **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
2 in. to 43 ft.	lbs./ft.	6 in. to 48 ft.

Open Hole from ft. to ft.

Screen YES **Make** JOHNSON **Type**

Diameter	Slot/Gauze	Length	Set Between
0	10	0	43 ft. and 46 ft.

Geological Material	Color	Hardness	From	To
FINE SAND	BROWN		0	28
VERY FINE SAND	GRAY		28	42
GRAVEL	GRAY		42	46
CLAY	GRAY		46	48

Static Water Level
2.3 ft. from Land surface Date Measured 05/11/1990

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Bentonite from 0 to 40 ft. 0

Located United States Geological Survey
Method Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number
Verification Information from owner
Date N/A
System *UTM - Nad83, Zone15, Meters*
X: 498167 **Y:** 4990877

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock
Last Strat Clay-gray
Aquifer Quat. Water Table Aquifer
Depth to Bedrock ft.

Well Contractor Certification

United States Geological Survey	USGS	STARK, J.
License Business Name	Lic. Or Reg. No.	Name of Driller

County Well Index Online Report

227977

Printed 10/30/2008
HE-01205-07

#10 City of Shoreview #1

Minnesota Unique Well No.
206833

County Ramsey
Quad New Brighton
Quad ID 119C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 09/17/2003
Received Date

Well Name SHOREVIEW 1

Township	Range	Dir	Section	Subsections	Elevation
30	23	W	35	BDCDDC	965 ft.

Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
536 ft.	536 ft.	05/00/1961

Drilling Method Cable Tool

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Community Supply **PWS ID** **Source**

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 2.5 ft.

Casing Diameter	Weight	Hole Diameter
20 in. to 129 ft.	lbs./ft.	19 in. to 536 ft.
12 in. to 465 ft.	lbs./ft.	

Open Hole from 465 ft. to 536 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Well Address

SHOREVIEW MN 55126

Geological Material	Color	Hardness	From	To
SANDY CLAY			0	80
CLAY			80	106
HARDPAN			106	128
LIMESTONE			128	156
SHALE			156	160
SANDROCK-ST. PETER			160	280
SHALE			280	283
SANDROCK-ST. PETER			283	320
SHAKOPEE			320	447
JORDAN			447	535
SHALE			535	536

Static Water Level
137 ft. from Land surface Date Measured 05/00/1961

PUMPING LEVEL (below land surface)
168 ft. after hrs. pumping 408 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☑ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
KROISS'S HILLS OF HOME ADD. BLK 13 LOT 1.
GAMMA LOGGED 10-29-1979.

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Neat Cement from 0 to 465 ft. 35 yrds.

Located Minnesota Geological Survey **Method** Digitized - scale 1:24,000 or larger (Digitizing Table)

Unique Number Verification Information from owner **Date** N/A

System *UTM - Nad83, Zone15, Meters* **X:** 488960 **Y:** 4987738

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed 00/00/1961
Manufacturer's name FAIRBANKS-MORSE Model number __ HP 50 Volts
Length of drop Pipe 211 ft. Capacity 500 g.p.m
Type Submersible Material Steel (black or low carbon)

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Borehole Geophysics Yes
First Bedrock Platteville
Last Strat Jordan
Aquifer Jordan
Depth to Bedrock 128 ft.

Well Contractor Certification

Keys Well Co.	62012	BRANDON
License Business Name	Lic. Or Reg. No.	Name of Driller

#11 City of St. Paul

Minnesota Unique Well No.
244360

County Ramsey
Quad St Paul West
Quad ID 103B

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 01/16/1992
Update Date 03/13/1992
Received Date

Well Name CITY OF ST. PAUL

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
29	23	W	35	BAD	888 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
234 ft.	234 ft.	12/21/1979

Drilling Method –

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 1 ft.

Casing Diameter	Weight	Hole Diameter
16 in. to 174 ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen YES **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between
16		60	174 ft. and 234 ft.

Geological Material	Color	Hardness	From	To

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
DNR OBWELL 62034

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed
Manufacturer's name FAIRBANKS Model number 12" MC
__ HP 50 Volts 440
Length of drop Pipe _ft. Capacity _g.p.m Type Turbine Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

License Business Name | Lic. Or Reg. No. | Name of Driller

First Bedrock
Last Strat
Aquifer St.Peter
Depth to Bedrock ft.

#12 Lake Johanna #19

Minnesota Unique Well No.
225652

County Ramsey
Quad New Brighton
Quad ID 119C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 03/12/2003
Received Date

Well Name JOHANNA LAKE UNIT NO. 19

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
30	23	W	33	ABDBDA	885 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
408 ft.	408 ft.	08/08/1958

Drilling Method –

Drilling Fluid –

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Public Supply/non-community **PWS ID** **Source**

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
16 in. to 200 ft.	lbs./ft.	

Geological Material	Color	Hardness	From	To
CLAY	RED		0	40
CLAY & GRAVEL			40	70
SAND & CLAY & GRAVEL			70	85
SAND & GRAVEL			85	110
LOOSE SAND & GRAVEL			110	125
ROCKS & GRAVEL & CLAY			125	132
SHALE & SAND			132	165
SANDSTONE & SHALE			165	180
HARD SANDSTONE			180	207
SHAKOPEE LIMESTONE			207	330
JORDAN SANDSTONE			330	405
ST. LAWRENCE			405	408

Open Hole from 200 ft. to 408 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
46 ft. from Land surface Date Measured 08/08/1958

PUMPING LEVEL (below land surface)
98 ft. after hrs. pumping 1000 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
GAMMA LOGGED 5/7/92.

Grouting Information Well Grouted? ☐ Yes ☐ No

Located United States Geological Survey

Method Digitized - scale 1:24,000 or larger (Digitizing Table)

Unique Number Verification N/A

Date N/A

System *UTM - Nad83, Zone15, Meters*

X: 486330 **Y:** 4988272

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Borehole Geophysics Yes
First Bedrock St.Peter
Last Strat St.Lawrence
Aquifer Multiple
Depth to Bedrock 165 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Layne Well Co.	27010	

#13 Ramsey Co, Workhouse

Minnesota Unique Well No.
200054

County Ramsey
Quad Lake Elmo
Quad ID 102B

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 01/22/2004
Received Date

Well Name CITY-COUNTY WORKHOUSE

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
28	22	W	12	AADBCB	1050 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
558 ft.	558 ft.	09/30/1960

Drilling Method Cable Tool

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No From Ft. to Ft.

Use Public Supply/non-community **PWS ID** **Source**

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
12 in. to 491 ft.	lbs./ft.	

Open Hole from 491 ft. to 558 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Well Address
100/LOWER AFTON RD
ST PAUL MN
1700 COURT HOUSE

Geological Material	Color	Hardness	From	To
DRIFT			0	120
SHALE			120	134
SHALE			134	142
SHALE			142	165
PLATTEVILLE			165	172
SAND AND SHALE			172	180
ST. PETER			180	320
SHAKOPEE			320	327
SHAKOPEE			327	442
SHAKOPEE			442	476
JORDAN			476	533
SHALE			533	558

Static Water Level
245 ft. from Land surface Date Measured 11/30/1959

PUMPING LEVEL (below land surface)
400 ft. after hrs. pumping 400 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
GAMMA LOGGED & TV 9-21-1993.

Grouting Information Well Grouted? ☑ Yes ☐ No

Located Minnesota Geological Survey **Method** Digitized - scale 1:24,000 or larger (Digitizing Table)

Unique Number Verification Information from owner **Date** 03/18/2004

System *UTM - Nad83, Zone15, Meters* **X:** 501031 **Y:** 4975381

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Borehole Geophysics Yes
First Bedrock Decorah
Last Strat Jordan
Aquifer Jordan
Depth to Bedrock 120 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Mccarthy Well Co.	27022	

#14 DNR - Belaire Beach - Deep

Minnesota Unique Well No.
551564

County Ramsey
Quad White Bear Lake East
Quad ID 118C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 11/07/1994
Update Date 02/20/2006
Received Date

Well Name BELLAIRE PARK MW.

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
30	22	W	24	DBCBBA	935 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
194 ft.	194 ft.	10/31/1994

Drilling Method Non-specified Rotary

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Monitor well

Casing Type Steel (black or low carbon) **Joint** Welded **Drive Shoe?** ☑ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 178 ft.	lbs./ft.	4 in. to 194 ft.

Well Address

WHITE BEAR LAKE MN

Geological Material	Color	Hardness	From	To
CLAY	BLACK	SOFT	0	5
CLAY	BROWN	SOFT	5	15
CLAY	GRAY	SOFT	15	18
CLAY/SAND LENS	BROWN	SOFT	18	30
MEDIUM SAND	BROWN	SOFT	30	36
MEDIUM SAND	BROWN	SOFT	36	78
ST. PETER	YELLOW	MEDIUM	78	105
BASAL ST. PETER	GRAY	MEDIUM	105	160
DOLOMITE	PNK/TAN	HARD	160	167
DOLOMITE	PNK/TAN	HARD	167	194

Open Hole from 178 ft. to 194 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
15 ft. from Land surface Date Measured 10/31/1994

PUMPING LEVEL (below land surface)
30 ft. after hrs. pumping 50 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
GAMMA LOGGED 11-3-1994.

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: from 0 to 177 ft. 40 bags

Located Minnesota Geological Survey **Method** Digitization (Screen) - Map (1:24,000)

Unique Number Verification Information from owner **Date** 09/03/2004

System *UTM - Nad83, Zone15, Meters* **X:** 500457 **Y:** 4990740

Nearest Known Source of Contamination
300 feet N direction Body of water type
Well disinfected upon completion? ☐ Yes ☑ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☑ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Borehole Geophysics Yes
First Bedrock St.Peter
Last Strat Prairie Du Chien Group
Aquifer Prairie Du Chien Group
Depth to Bedrock 36 ft.

Well Contractor Certification

Renner E.H. Well	71015	PRAUGHT, V.
License Business Name	Lic. Or Reg. No.	Name of Driller

#15 Bel Aire Beach DNR well #2

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Minnesota Unique Well No. **551575**

County Ramsey
Quad
Quad ID

Entry Date 02/09/2006
Update Date 02/09/2006
Received Date 0

DNR well # 62045

Well Name DEPT OF NATURAL RESOURCES
Township Range Dir Section Subsections Elevation ft.
30 22 W 24 DBB
Elevation Method

Well Depth	Depth Completed	Date Well Completed
31 ft.	31 ft.	10/01/1994

Drilling Method Cable Tool

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Test well

Casing Type Plastic **Joint** Welded **Drive Shoe?** ☐ Yes ☐ No **Above/Below ft.**

Casing Diameter	Weight	Hole Diameter
2 in. to 27.7 ft.	0.8 lbs./ft.	6.5 in. to 31 ft.

Well Address
BELLAIRE PARK SIT
MN

Open Hole from ft. to ft.

Screen YES **Make** JOHNSON **Type** plastic

Diameter	Slot/Gauze	Length	Set Between
2	10	5	25 ft. and 30 ft.

Geological Material	Color	Hardness	From	To
CLAY	BLACK	SOFT	0	5
CLAY	BROWN	SOFT	5	15
MED SAND	BROWN	MEDIUM	15	30
CLAY	RED	MEDIUM	30	31

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Neat Cement from to 24 ft. 6 bags

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP _ Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☑ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

Renner E.H. Well	71015	PRAUGHT, V
License Business Name	Lic. Or Reg. No.	Name of Driller

First Bedrock
Last Strat
Aquifer
Depth to Bedrock ft.

#16 White Bear Lake #3

Minnesota Unique Well No.
225647

County Ramsey
Quad White Bear Lake East
Quad ID 118C

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 08/14/1991
Update Date 01/18/2003
Received Date DNR #62046

Well Name WHITE BEAR LAKE UNIT 3

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
30	22	W	13	BABAAC	928 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
827 ft.	827 ft.	00/00/1926

Drilling Method Cable Tool

Well Address

WHITE BEAR LAKE MN

Geological Material	Color	Hardness	From	To
CLAY & SAND & GRAVEL			0	15
SAND			15	55
BLUE CLAY			55	87
SAND & GRAVEL			87	152
SAND & GRAVEL			152	173
SOAP & LIMESTONE			173	187
LIMESTONE			187	250
LIMESTONE			250	290
SANDSTONE			290	333
SANDSTONE			333	364
SANDSTONE			364	384
GREEN SHALE			384	400
GREEN SHALE			400	415
BLUE & GREEN SHALE			415	558
BLUE & GREEN SHALE			558	570
SANDSTONE			570	614
SANDSTONE			614	620
SANDY LIMESTONE			620	632
LIMESTONE			632	713
LIMESTONE			713	733
SANDSTONE			733	827

REMARKS
GAMMA LOGGED 5-21-1996.

Located Minnesota Geological Survey
Method Digitized - scale 1:24,000 or larger (Digitizing Table)

Unique Number Verification Information from owner
Date N/A

System *UTM - Nad83, Zone15, Meters*
X: 500185 **Y:** 4993330

Borehole Geophysics Yes
First Bedrock Prairie Du Chien Group
Last Strat Mt.Simon
Aquifer Multiple
Depth to Bedrock 152 ft.

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Lake level augmentation

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** 0 ft.

Casing Diameter	Weight	Hole Diameter
20 in. to 173 ft.	lbs./ft.	

Open Hole from 173 ft. to 827 ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
31 ft. from Land surface Date Measured 08/02/1949

PUMPING LEVEL (below land surface)
57 ft. after hrs. pumping 1200 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed
Manufacturer's name FAIRBANKS MORSE Model number __ HP 30 Volts 220
Length of drop Pipe 30 ft. Capacity _g.p.m Type Turbine Material

Abandoned Wells Does property have any not in use and not sealed well(s)?
☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Mccarthy Well Co.	27022	

White Bear Lake #3

Appendix F

Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas, Minnesota Department of Health

Evaluating Proposed Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas

December, 2006

Introduction

Infiltration is widely promoted because it is a practice with demonstrated long-term value in managing storm water. As a management technique, properly designed and executed infiltration techniques convey several benefits, including the following (as identified in the Minnesota Storm water Manual): 1) reducing the volume of storm water runoff; 2) controlling and improving water quality; 3) recharging groundwater; 4) mitigating thermal affects on cold-water fisheries; and 5) attenuating peak flows. Infiltration is clearly a versatile and effective technique for addressing a wide range of storm water issues. Accordingly, MDH encourages its use in most settings statewide.

Infiltration practices redirect storm water into the subsurface, where it becomes groundwater. As most people in Minnesota use groundwater as a source of drinking water, the Minnesota Department of Health (MDH) would like to see care exercised in planning projects involving storm water infiltration, especially in vulnerable wellhead protection areas.

Storm water runoff often carries with it contaminants that can lead to adverse health effects. The types of contaminants vary widely depending on land use; common contaminants include nitrates, pathogens, metals, chloride, and hydrocarbons. When present at high concentrations, these contaminants can pollute groundwater supplies if infiltrated into the ground. The effects of such contamination can be devastating. An example involving not urban storm water but runoff from agricultural fields in Ontario illustrates the danger posed by pathogens. Infiltration of the runoff led directly to bacteriological contamination of a well and the associated public water supply system. The resulting disease outbreak took several lives and sickened hundreds of others. This example not only demonstrates the potential for rapid connection between surface water and groundwater, but it clearly indicates that groundwater quality can be jeopardized by infiltration of storm water from the ground surface.

Most of the public water supply systems that distribute drinking water in Minnesota rely on groundwater as their source. Drinking water protection activities are the responsibility in Minnesota of the MDH. As part of these efforts, MDH regulates wellhead protection planning activities carried out by public water suppliers in the state. One of the goals of wellhead protection planning is to determine the recharge area (i.e., the wellhead protection area) for a well and to manage that area in a manner consistent with safeguarding the drinking water supply.

Storm water management occurs in urban or suburban areas and in developing communities where impervious surfaces begin to replace natural ground cover. This document describes suggested considerations for evaluating projects that use infiltration

to manage storm water, with emphasis on how such projects may affect groundwater used for drinking water purposes in wellhead protection areas. A flowchart (Appendix A) is attached to help understand the process.

General Requirements

Federal, regional and state authorities regulate various aspects of the manner in which storm water is handled, managed, and controlled in Minnesota. For example, the Minnesota Pollution Control Agency (MPCA) administers the Storm Water program, which regulates much of the management of storm water through the use of permits. The MPCA, regional and local authorities are typically the governmental entities implementing and enforcing storm water requirements. This guidance applies regardless of whether the storm water management at the site is regulated or not.

The Minnesota Department of Health has no regulatory authority over most routine handling of storm water, but does administer the Wellhead Protection Program and other drinking water protection programs. Wellhead protection planning is largely a local activity in Minnesota. Individual public water supply systems decide how to manage land use within wellhead protection areas. Certain land use activities may adversely affect ground water supplies. Therefore wellhead protection strategies are balanced with aquifer vulnerability. As wellhead protection planning and storm water management both involve a substantial amount of local government involvement and leadership, good opportunities exist for adopting a consistent approach in the application of each.

Assembling Existing Information

This document is intended for use as guidance for local authorities in evaluating storm water infiltration projects. Prior to doing so, existing information must be gathered, as described in this section.

- *Is your proposed project in an approved wellhead protection area?* Information in a wellhead plan may help to evaluate proposed infiltration projects. Copies of the report are usually kept with the wellhead protection manager for the public water supplier. While municipalities are typically the largest groundwater users for public consumption, other entities that may have wellhead plans are schools, mobile home parks, and large businesses or employers. Step 1, below, describes how to identify wellhead activities in your area of interest.
- *What aquifer is used by drinking water supply wells in the area of the proposed infiltration?* It is important to know the aquifer used by area wells because in some parts of the state, many potential aquifers are available and depending on local geology, each aquifer may have a different sensitivity to activities at the ground surface.
- *Where is the aquifer(s)vulnerable to contamination from activities at the land surface?* Vulnerability means the degree to which the aquifer is likely to be affected by activities at the ground surface. A wellhead protection plan distinguishes between zones within the wellhead protection area that are

vulnerable from those that are not. Understanding this characteristic helps in evaluating the risk posed by activities like storm water management.

- *What land uses exist or are proposed for the area generating storm water?* Local authorities are the best source of information on local land use. Land uses vary in their potential to generate contaminants in storm water runoff. For example, potential contaminants from industrial or commercial areas are far different from those that may be generated from park or residential areas. The Minnesota Stormwater Manual (links in Appendix B) describes certain land uses that it terms "potential stormwater hotspots (PSH)" that may be incompatible with infiltration in wellhead protection areas. Land use is very hard to characterize broadly. Accordingly, site-specific considerations should be made wherever possible. Consult the Minnesota Stormwater Manual for information on land uses and associated storm water problems.
- *What are the contaminants of concern in the storm water and can contaminants be managed?* Do the storm water management protocols identify any type of pre-treatment that may help to mitigate contaminants in the runoff and are they appropriate for the types of contaminants that are likely to be present in the storm water?

Each of these items is considered as part of the evaluation process that MDH proposes for considering storm water infiltration projects in vulnerable wellhead protection areas. The process is described below and is summarized in the flowchart attached as Appendix A.

Process for Evaluating Storm Water Infiltration Projects

Step 1: **Determine if any part of the proposed infiltration site is within a vulnerable wellhead protection area (WHPA) or drinking water supply management area (DWSMA) as defined by Minnesota Rules (4720.5100-5590).** This information is available from the Wellhead Protection Manager at the public water supplier or from MDH staff (651-201-4700). Also, the wellhead protection plan likely contains a section describing the vulnerability assessment, which describes how the vulnerability is determined and how it may vary throughout the DWSMA.

The term 'infiltration site" refers to any structure or device designed to transfer surface waters to the subsurface. In practice, these facilities range in size from rain gardens designed to handle runoff from residential rooftops to basins collecting runoff from large commercial areas. The scale of the infiltration project, in terms of the volume of storm water handled, clearly must be considered, along with land use, as part of this review process. MDH generally encourages multiple small-scale infiltration projects distributed over a large site in lieu of one large structure to handle storm water from a site.

> **If yes, proceed to Step 2**. Yes means that the infiltration site is in close proximity to wells used to supply a public water supply system. The wellhead report may indicate the travel time in years between the proposed site and the wells. A vulnerable determination (very high, high, or moderate vulnerability) means the

aquifer will likely be affected by activities at the ground surface. Hence, the proposed infiltration needs to be considered in more detail.

If no, it is unlikely that the proposed storm water management project will affect drinking water supplies for a public water supply system (with a defined wellhead area), but the project still must comply with MPCA and local requirements for storm water handling.

Step 2: **Does the aquifer receiving the water from the infiltration basin exhibit fracture or solution-enhanced groundwater flow conditions (secondary porosity features)?** This means groundwater flow through rocks or other geologic materials exhibiting porosity is dominated by fractures or dissolution features (examples include the Prairie du Chien Dolomite and the Galena Limestone). Aquifers characterized by secondary porosity can display extremely rapid groundwater travel times that can put a well at risk in a matter of hours and can have complicated and tortuous flowpaths that are difficult to predict without special testing. Infiltration of stormwater within WHPAs is not recommended in such settings, especially if karst features exist. Infiltration might be acceptable if the karst aquifer is covered by 100 feet or more of other materials. The Minnesota Stormwater Manual identifies karst settings as especially problematic in managing storm water. Appendix B contains web links to the complete stormwater manual, which should be consulted for more background on managing storm water in karst areas, as well as maps showing the location of Minnesota's karst areas.

If no, proceed to Step 3.

If yes, infiltration may not be appropriate for this setting. Consider other storm water handling procedures such as storm water retention and conveyance outside of the WHPA or moving the infiltration area to a non-vulnerable part of the DWSMA. Additional handling alternatives are presented in the Minnesota Stormwater Manual (see reference in Appendix B).

Step 3: **Is the proposed infiltration site within the 1-year time-of-travel (emergency response zone) as designated by MDH?** A 1-year travel time is significant for several reasons. Most pathogens are not viable in the groundwater after 365 days. So a 1-year travel time represents a margin of safety that will allow some contaminants to attenuate or, additionally, sufficient time for local authorities to react.

If no, proceed to Step 4.

If yes, infiltration is not appropriate in this setting as insufficient time is available after infiltration to cause pathogens to die off or for local authorities to react to a spill. Extenuating circumstances here might be the presence of a sufficiently thick unsaturated zone between the water table and the base of the infiltration site that pathogen attenuation would take place.

Step 4: **What current or proposed land uses drain into the infiltration site?**

Classify the predominant land use upgradient of the infiltration site into one of the following categories:

1. Commercial and industrial;
2. Transportation corridors;
3. Forest, parkland, open space;
4. Low density residential;
5. High density residential; and
6. Golf course, active agricultural (i.e., cropland, feedlots).

Storm water infiltration in commercial and industrial areas, as well as in transportation corridors is only appropriate if the collection and infiltration system is designed to allow spill containment. MPCA permitting requirements currently prohibit infiltration from industrial areas containing exposed potential contaminant sources or from vehicle fueling or maintenance areas. Categories 3 through 6 represent land uses from which infiltrated runoff is not as likely to contain contaminants that may adversely affect human health if introduced into a drinking water supply, although this may depend on 1) the degree to which land management BMPs have been adopted, and 2) storm water pretreatment measures. The use of storm water infiltration devices may be acceptable in areas where they would otherwise be inappropriate if flows from, say, rooftop drainage could be collected for infiltration separate from runoff from industrial areas.

The land use categories presented here are quite broad and there will be differences in the kinds of contaminants that could be generated in runoff from each. The Minnesota Stormwater Manual contains a lengthy discussion (chapter 13) about potential stormwater hotspots (PSHs), which are land uses that have the potential to affect the water quality of storm water. The Minnesota Stormwater Manual describes conditions under which infiltration of runoff from land uses containing PSHs as a practice is not appropriate. Users of this guidance should be familiar with the PSHs identified in the Minnesota Stormwater Manual as a means of providing context for evaluating general land uses. While the manual identifies many PSHs, the list is not exhaustive, and each land use should be considered on its own merits.

Step 5: (This step does not apply to some land uses – see flow chart): **Are emergency procedures for containment of spills established and acceptable?** The primary concern here relates to transportation corridors. Fuels, chemicals, and other potentially hazardous materials all are moved on roadways and railways. Accidents that happen in unpredictable locations have the potential to affect groundwater. While it may not be practical to design protections against the eventuality of all possible such accidents, local and regional authorities should have a means of responding should a spill occur.

> **If no**, infiltration is not appropriate in this setting.
>
> **If yes**, infiltration may be acceptable but only if contingency responses for spill containment are included in the site planning process.

***Step 6*: Are site planning, BMPs, pre-treatment, or secondary containment measures acceptable to meet federal drinking water standards?** Regardless of the approach used, the goal should be that the water entering the infiltration basin must meet federal drinking water quality standards. Such standards may be more stringent than is required by MPCA for routine considerations of storm water management.

> **If no**, infiltration is not appropriate in this setting.
>
> **If yes**, planned infiltration appropriate unless site conditions differ in a manner likely to affect storm water quality adversely thereby not meeting drinking water standards.

Special Situations

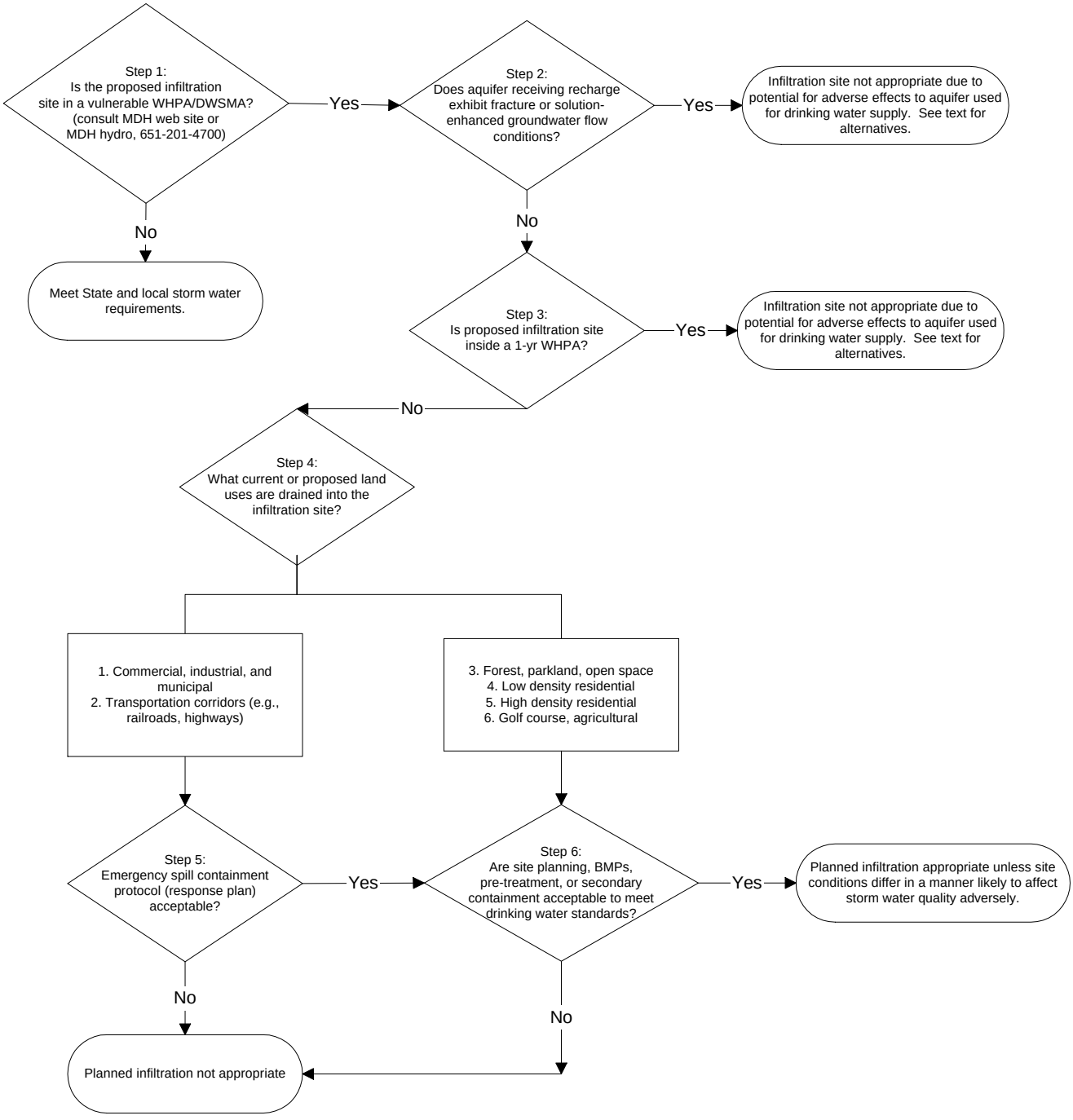
Certain circumstances may dictate a response to the proposed infiltration different from the recommendations of this guidance. For instance, a project involving the infiltration of volumes of water that are large relative to the amount pumped by a nearby well may leave little room for natural processes to dilute the storm water. Or perhaps specialized predictive tools, such as a groundwater flow model, are available that can help to forecast the effects of the infiltration. Such tools may make it easier to interpret likely effects of the proposed infiltration. While it is impossible to predict all such extenuating circumstances, it will be the role of the user to decide how to incorporate such conditions in the analysis of site-specific infiltration proposals.

Contacting Minnesota Department of Health Staff

Appendix B lists various resources available to help work through this guidance, including MDH staff contacts. MDH hydrologists are generally assigned to specific regions of the state (see Appendix B) but additional assistance is available by calling the Source Water Protection Unit at 651-201-4700.

Appendix A

Appendix A.
A Flow Chart for Evaluating Proposed Storm Water Infiltration Projects in Areas with Vulnerable Groundwater



Note: This flow chart intended for use in conjunction with MDH guidance on evaluating storm water infiltration projects in vulnerable wellhead protection areas.

Appendix B

Appendix B

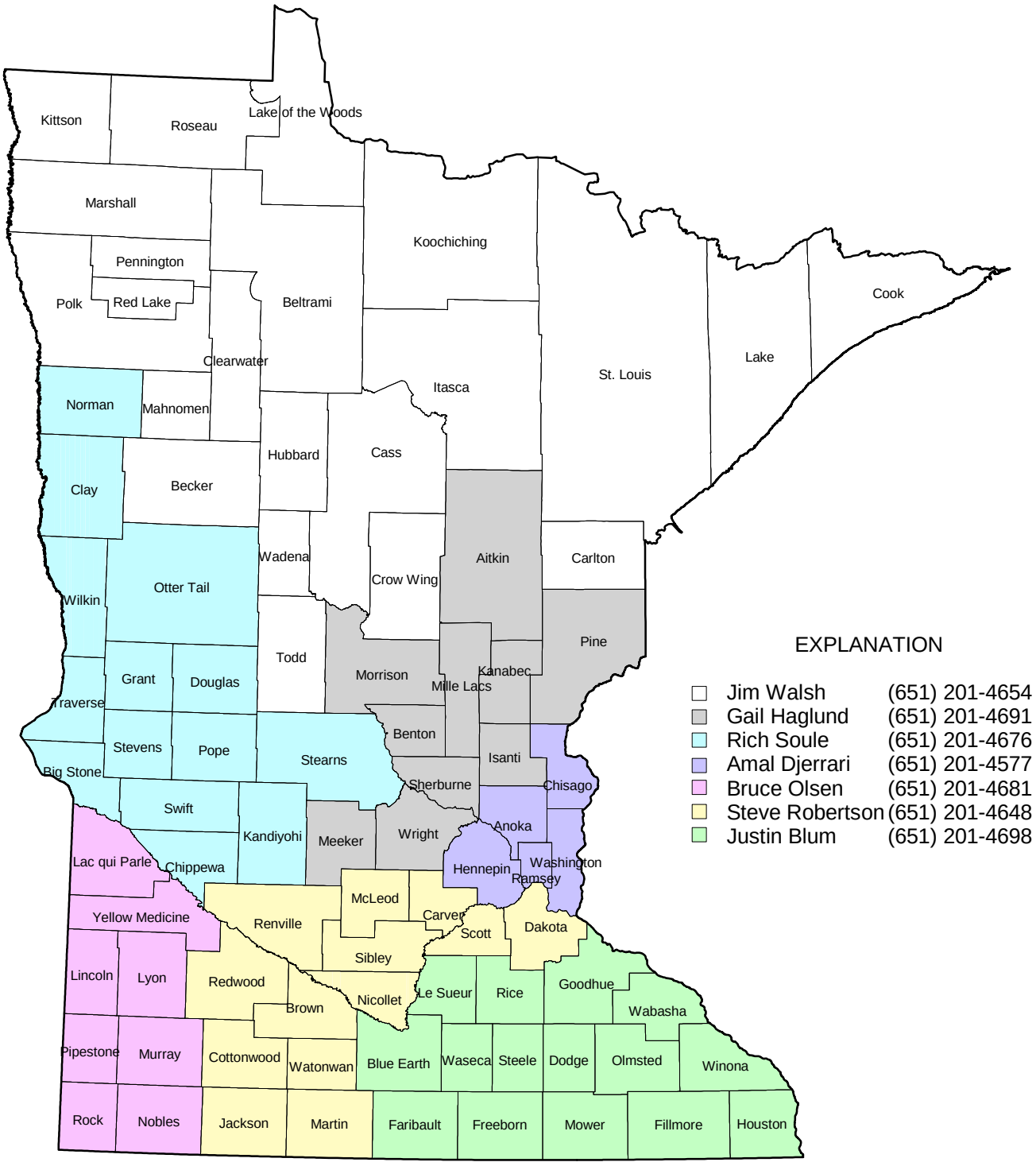
Minnesota Stormwater Manual

www.pca.state.mn.us/water/stormwater/stormwater-manual.html

MDH Hydrologists by Region

See map on next page.

Hydrologist Areas, Wellhead Protection



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Appendix G

Municipal Well Sensitivity

Minnesota Department of Health

Water Well Sensitivity (MDH)
Ramsey County

Gem Lake Hills Golf Course							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
448252	Well #1	108'	Primary	Glacial Deposits	Low	Not Susceptible (2)	No

Mounds View Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
206721	Well #1	836	Primary	Frank-Mt. Simon	Low	Not Susceptible (2)	No
206716	Well #2	835	Primary	Mt. Simon	Low	Not Susceptible (2)	No
206720	Well #3	350	Primary	Jordan/St. Law.	Low	Not Susceptible (2)	No
206722	Well #5	350	Primary	Pr. du Ch./Jordan	Low	Not Susceptible (2)	No
206717	Well #6	679	Primary	Jordan/Mt. Simon	High	Not Susceptible (2)	No

New Brighton Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
206793	Well #3	495	Primary	Pr. du Ch./Jordan	Low	Not Susceptible (2)	No
206792	Well #4	500	Primary	Pr. du Ch./Jordan	Low	Not Susceptible (2)	No
206796	Well #5	501	Primary	Jordan	Low	Not Susceptible (2)	No
206797	Well #6	522	Primary	Jordan	Low	Not Susceptible (2)	No
206795	Well #8	492	Seasonal	Pr. du Ch./Jordan	Low	Not Susceptible (2)	No
206794	Well # 9	937	Backup	Mt. Simon	-	-	-
161432	Well #10	931	Seasonal	Mt. Simon	Low	Not Susceptible (2)	No
509083	Well #11	950	Seasonal	Mt. Simon	Low	Not Susceptible (2)	No
110485	Well #12	790	Seasonal	Mt. Simon	Low	Not Susceptible (2)	No
554216	Well #14	295	Primary	Pr. du Chien	Low	Not Susceptible (2)	No
582628	Well #15	245	Primary	Pr. du Chien	Medium	Not Susceptible (2)	No

North Oaks Wells (Private Wells)

North St. Paul Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
208222	Well #1	470	Primary	Pr. du Chien	High	Not Susceptible (2)	No
208223	Well #2	470	Primary	Pr. du Ch./Jordan	High	**Susceptible (1)**	No
208224	Well #3	468	Primary	Jordan	High	Not Susceptible (2)	No
205744	Well #4	475	Primary	Jordan	High	Not Susceptible (2)	No
112229	Well #5	531	Primary	Jordan	High	Not Susceptible (2)	No

Saint Anthony Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
200804	Well #3	539	Back-up	Pr. du Ch./Jordan	-	-	-
200803	Well #4	541	Primary	Jordan	Low	Not Susceptible (2)	Yes
200524	Well #5	472	Primary	Jordan	Low	Not Susceptible (2)	Yes

Saint Paul Regional Water Service Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
133312	Well B	438	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes
127292	Well C	442	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes
151583	Well D	451	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes
151579	Well E	463	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes
706803	Well F	465	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes
706802	Well G	465	Primary	Pr. Du Ch./Jordan	High	Not Susceptible (2)	Yes

Water Well Sensitivity (MDH)
Ramsey County

Shoreview Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	**Well Sensitivity**	**SWPA**
206752	Well #2	395	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	No
206751	Well #3	413	Primary	Jordan	High	Not Susceptible (2)	No
206750	Well #4	423	Primary	Glacial Deposits	High	Not Susceptible (2)	No
151557	Well #5	408	Primary	Jordan	High	Not Susceptible (2)	No
151576	Well #6	414	Seasonal	Eau Claire/Mt. Sim.	High	Not Susceptible (2)	No
432019	Well #7	442	Primary	Jord./St. Lawrance	High	Not Susceptible (2)	No

Vadnais Heights Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	***Well Sensitivity**	**SWPA**
127265	Well #2	470	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
224790	Well #3	495	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
127271	Well #4	476	Primary	Jordan	High	Not Susceptible (2)	Yes

White Bear Lake Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	***Well Sensitivity**	**SWPA**
014005	Well #1	490	Primary	Jordan	High	Not Susceptible (2)	No
222880	Well #2	970	Primary	Ironton/Mt. Simon	High	Not Susceptible (2)	No
205733	Well #3	513	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	No
226566	Well #4	476	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	No
244359	Well #5	96	Primary	Glacial Deposits	Low	Not Susceptible (2)	No

White Bear Township Wells							
Unique Well No	**Well ID**	**Depth**	**Well Use**	**Aquifer**	**Aquifer Sensitivity**	***Well Sensitivity**	**SWPA**
226570	Well #1	445	Primary	Jordan	High	Not Susceptible (2)	Yes
676446	Well #2A	420	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
224679	Well #3	372	Seasonal	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
226572	Well #4	408	Seasonal	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
151596	Well #5	412	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes
596636	Well #6	360	Primary	Pr. du Ch./Jordan	High	Not Susceptible (2)	Yes

Well Sensitivity - Well sensitivity refers to the integrity of the well due to its construction and maintenance. It is based on the results of the well construction assessment. It can be one of the following:

(1) The well is susceptible to contamination because it does not meet current construction standards or no information about well construction is available, regardless of aquifer sensitivity.

(2) The well is not susceptible because it meets well construction standards and does not present a pathway for contamination to readily enter the water supply.